THE

ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1901 Edition

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THE BRITISH PRESS AND BRITISH INDUSTRY.

IN these ultra-patriotic days, when all the nation—save the small and righteous-minded minority—has been "a-mafficking," it seems strange that one should have to lay serious complaint against British journalism for its studiously unfair attitude towards an important home industry.

There never was a time when the English electrical manufacturer had to fight so hard to maintain his position in the markets. He has to compete against rivals who can employ cheap labour and obtain raw material at low prices, and, in short, he has to sell his goods in competition with the surplus production of other nations. Those conditions are bad enough, but if that were not sufficient the newspapers have taken it upon themselves to educate the public up to the point of using foreign-made plant, to the exclusion of that which has had the misfortune to be made in this country.

Last century the term "made in Germany" was used almost in opprobrium, but nowadays it is a distinct recommendation to some people. It is not merely that the efforts of the English manufacturer have rarely called forth the commendations of the press, but journalists have vied with each other in decrying the productions of English workshops. Nor is this spirit of self-depreciation confined to an irresponsible section of the press, for the most reputable of the daily organs have frequently borne witness to the superiority of foreign-made plant. It is not more than two or three days ago that the "Johnny Head in Air" representative of an influential daily paper dwelt in sorrowing terms upon the absence of the British electrical manufacturer from the Glasgow Exhibition, yet there is, in truth, hardly an important firm which is not in some way or other represented at Glasgow.

It is, apparently, taken for granted that no good electrically can come out of the country, and that it is useless to discuss it further. Unfortunately, this attitude of the press has a most serious influence upon the public, who are, through the agency of municipalities, large purchasers of electrical apparatus; we are not sure that it has not been without its influence upon the minor consulting engineers, one of whom recently declared in connection with a scheme, that he was not going to make experiments, and forthwith put in American plant; yet English manufacturers had made this very type of plant over and over again.

No doubt a good deal of the indiscriminate praise of the daily press is due to ignorance of the true conditions which prevail, but the foreign manufacturer being a business man, is not slow to avail himself of it. Ignorance is not, however, always responsible for the hostile attitude towards home manufacturers, and certainly no technical or engineering journal could plead it as an excuse for the studied neglect of English work, and the everlasting exploitation of foreign-

made machinery. Yet one of the foremost of English engineering journals has missed no opportunity of extolling foreign electrical machinery, while it has preserved an almost unbroken silence on the subject of English productions.

The main support of any journal printed and published in this country is among home manufacturers, and while this fact ought not to blind it to the merits of foreign work, from mere business reciprocity it should not neglect its customers. It is not that English machinery is conspicuously bad, on the average it is equal to the best productions of either America or the Continent. It is true that at times of necessity, and at times which were otherwise, America has sent us excellent examples of electrical machinery; it has, moreover, offered on occasions outlets for the capital of English investors, albeit some of these outlets have had no bottom to them; but though American engineers may have served as nurses to English electrical undertakings, they have done nothing to warrant the indiscriminate laudations of the daily and, to some extent, the technical press.

Not for a moment would we suggest that our American friends have not deserved much of the success they have achieved on this side; of them, indeed, we make no complaint, but we do seriously protest against the crusade of depreciation of English manufacturers which the British Press continues to carry on.

The Education of Engineers.

THE presidential address of the President of the Institution of Mechanical Engineers deals with the education of engineers, an important if well-worn subject. We are all apt to think that technical education in Germany is accountable for much of the German advance. This is open to grave doubt. The Hohe-Schule youth is not thought much of in Germany. We have heard him spoken of with a good deal of contempt. Mr. Maw, in his address, seemed to us to lay too much stress upon specialising. He would have technical colleges specialised so that different colleges would obtain a character for special lines of work. Now if there is a more pitiable object in this world than another it is the specialist who has confined himself very narrowly to one line of work, who has no private means, and has not the special ability that will always find him a position; and after all, not everybody can rejoice in the ability to deserve or to obtain it.

The all-round man may not secure so good a salary, though this does not follow, but he is more likely to be able to find a fair situation in a short time. It is by no means superexcellent practice to be a specialist, especially for the man who cannot get into special circles. Men who have particular influence in railway circles and get early into locomotive work, for example, do become specialists in this particular work and advance to good positions if these open up, but advance is very much as it is in the Civil Service—a case of succeeding to dead men's shoes. There is still much to be said in favour of a good grounding in theory as given at our best colleges, coupled with home study. If a youth is so fortunate as to have a place to enter when he leaves college, he may, during his third year or last year, as the case may be, give special study to the particular line in which he is to engage.

As a mechanical engineer, Mr. Maw dwelt a good deal upon manufacturing processes, as though all engineers would be occupied in making something. This is far from the case. Many engineers hardly see the inside of a manufactory after they have left it. Their first work may happen to be that of assistant to a resident engineer, and they may next become residents themselves. Their duty will be simply to carry out designs made by the head office staff or the consulting engineer, and years may pass before any work comes to hand other than repairs, construction to plan, and general administration. It is during this part of the young engineer's experience, when he is in daily touch with men and materials, that he can best receive his technical education by applying his college training to solve problems as they arise, and by constant study, aided by the technical press.

The advice we would give a student of engineering is to go as early as possible to a good public school, and take the regular course up to 15 or 16 years of age; then to spend a year or two in a works, to become familiar with work and dirt, men and manners, or the want of them, and finally take a three years' college course, all through the period having spent half his spare time in private study. At the end of it all, let him get the first job to be had, even if only that of a switchboard attendant, but if fortunate in securing a job some months before the close of the college course, let him occupy these months in special work, and if his capacity does not warrant it, let him neglect the prize examinations. On this point, however, it is well to remark that a student may require to be of more than ordinary working powers and persistence to throw over the incitement of a prize, and to work as hard for the future; to prepare, in fact, for the position in view.

Electrolysis of Gas Pipes.

Two or three weeks ago we published an article very strongly criticising the action of the President and one of the Past-Presidents of the I.E.E. in connection with certain evidence they gave, which had the result of imposing on the Sheffield tramway system a serious responsibility in connection with the wearing out of gas pipes. The effect of the clause inserted in the Bill, as a result of this evidence, will be endless litigation, and attempts to make the tramway system responsible for all sorts of deterioration of pipes. For example, it is well known that pipes in some soils will last practically indefinitely, whilst in others they will be dissolved in a few years. Such differences are very likely to be ascribed to electrical action, so that gas and water companies, armed with this obnoxious clause, will be able to make it very difficult for tramway people to conduct their business.

The fact that so far it has not been found possible to produce a single instance of electrolytic action traceable to tramway working under the Board of Trade Regulations, ought to have prevented the insertion of this clause, but the evidence of the professors as to what might conceivably take place under laboratory conditions, coupled with their connection with the I.E.E., was sufficient to cause grave injustice to be done.

Fortunately the action of this Committee has not been repeated by the committee on the Bexley Tramway, for which Messrs. Mordey and Dawbarn are the engineers. Although the gas and water companies put forward the same evidence, the Committee has refused to insert the clause, and no doubt was largely led to its decision by the very unsatisfactory character of the evidence given by Prof. Perry and Prof. Ayrton when under cross-examination.

Two examples will be sufficient for engineers. Prof. Perry based certain statements on the supposition that the cars took an average of 40 amperes, and that all the earth leakage current found its way back by the gas pipes. He was forced to admit that the average current was hardly ever likely to exceed 15 amperes, and that he had taken the maximum current, and treated it for the purpose of his calculation as if it were the average current. He was further compelled to admit that he knew the whole current would not travel by the pipes, but probably only a small part of it. His colleague, Prof. Ayrton, showed the effect of electrolytic action on two iron plates immersed in brine about a quarter of an inch apart with a pressure of nearly 1½ volts direct on them continuously, the suggestion being that this represented the practical conditions that occur in our roads!

Fortunately, the Committee failed to be convinced by such evidence as this, and we think that our readers will agree with the Committee.

We do not for one moment desire that the electrical industry should be protected to the detriment of other industries, or that companies carrying out useful public work, such as the supply of gas or water, should be in any way penalised by the operations of electrical companies. What we object to, however, and object to most strongly, is that Parliamentary Committees should be misinformed on the actual and well known facts in connection with this part of the subject, as must always be the case when people who are not familiar with it are called in to give evidence.

THE KINGSLAND MECHANICAL SURFACE CONTACT SYSTEM.

We are now enabled, by the courtesy of the inventor, to give the following particulars of the above system, which, as we stated in our last issue, was recently inspected in operation by the Wolverhampton Corporation.

The principal feature of that system, on the evolution of which Mr. Kingsland has been engaged for several years, is the employment of a revolving tappet wheel to work the switches, operated by striker bars attached to the cars. The wheel is placed in a slot between the tram rail and an additional rail, into which the striker bar projects, and the switch is enclosed in a water-tight box beneath the pavement. The contact studs are, as usual, placed midway between the rails, and the return circuit is made by the rails themselves. It is claimed that the operation of the switches by a positive mechanical action does away with the difficulties and uncertainty with which the surface contact principle has generally been associated.

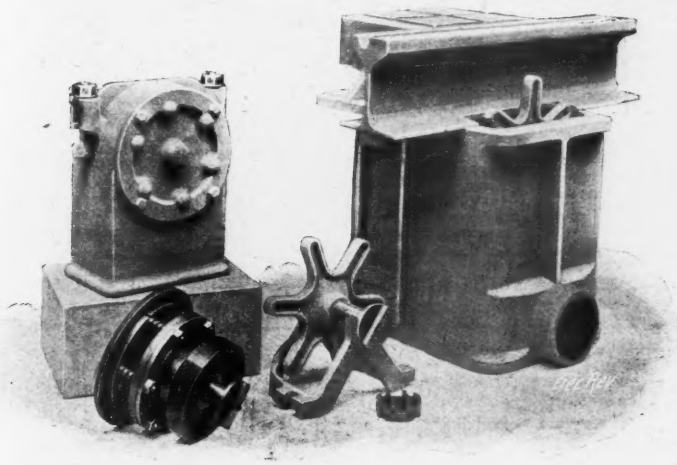


Fig. 1.

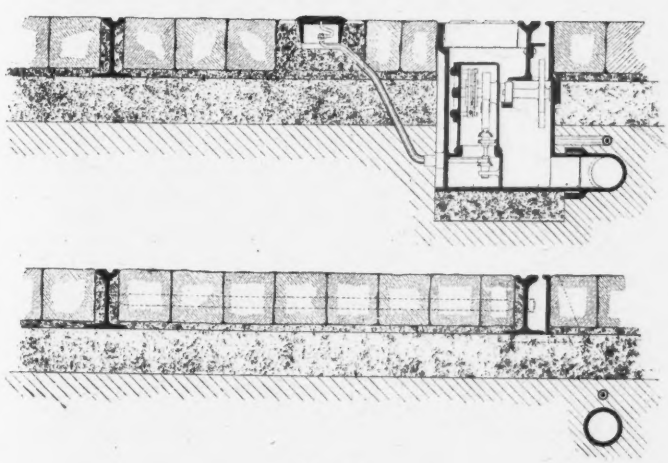


Fig. 2.

The principal parts of the apparatus are shown in the photograph, fig. 1, which includes the outer switch box, with a portion of running rail, the inner switch box, the switch and automatic stop, and the tappet wheel and bracket. Sections of the track at a switch-box, and between two boxes, are given in fig. 2, showing the general arrangement of the construction, while fig. 3 is a sectional end view of the outer and inner boxes in position.

Referring to this figure, R is one of the tram rails, and R′ is the outside or slot rail, forming in conjunction with R the slot S. D is a cast-iron street box, having a removable cover F, and containing the inner switch box H, and the tappet wheel L, which is mounted on a bracket B. The switch box H is clamped down on a water-tight joint J by means of bolts and lugs. On unscrewing these, box H with all its contents can be lifted out of the outer box D, for inspection or removal; and the bracket B and tappet wheel L can also be removed in a similar manner. Thus every part is perfectly accessible, and can be inspected or renewed in a few minutes.

The spindle A, which carries the switch mechanism, passes through a water-tight gland in the box H, and is coupled at E to the spindle C which carries the tappet wheel. The main and branch conductors, M, pass through water-tight glands into the bottom of the box D, and are connected by means of terminal pins and sockets with the contact brushes T, of the commutator switch W. The action of this is shown in figs. 4 and 5, fig. 4 being an "on" position, and fig. 5 an "off" position. Fig. 6 shows the tappet wheel and strikers.

The body of the commutator is made of insulating material, imbedded in which are three contact pieces, *a*, *b*, *c*, joined together by a metal ring (figs. 4 and 5). The contact brushes T, T′, are placed so that in one position of the commutator they will both be in contact with the metal portion, while in another position they will both be insulated. It will readily be seen that as the tappet wheel has six arms, and is moved one-sixth of a revolution each time it is operated, there will be three "on" positions and three "off" positions of the commutator during one complete revolution, and that these on and off positions occur alternately.

The electric circuit is never broken on the switch, as the switch in advance of a car is always put "on" before the rear switch is put "off."

For this switch the following advantages are claimed:—There is no sparking at the contacts; the contacts are always maintained at uniform pressure, and cannot stick, and there is practically no wear.

In order to prevent the wheel and switch from being carried round too far by their momentum when a car is travelling at a high speed, an automatic locking device has been devised, which relieves the shock of the blow by means of springs, and ensures the stoppage of the switch on the completion of one-sixth of a revolution. This is shown at K, fig. 3, and in section in fig. 7. This automatic stop is an exceedingly clever device, but is somewhat difficult to describe, although its working is quite simple. Opposing rings of segmental screw threads, facing in opposite directions, and some of which are free to move axially, but not by rotation, are so interlocked that it is impossible for the switch to rotate more than one-sixth of a revolution, yet upon the completion of that movement the respective parts are instantly returned by springs to the normal position, ready for the next operation. The apparatus has been tested up to a speed of 20 miles per hour without failure.

The electrical connections are arranged in two systems, depending on whether each car carries one striker or two.

Fig. 8 illustrates the arrangement when only one striker is used on the car. R R are the tram rails, M is the main electrical conductor. S M^1, S M^2, are sectional mains connecting the commutators in one switch box with the corresponding commutators in the next box. The studs S^1 S^2, &c., are permanently connected to the metal portion of one commutator through the cable *e*, and the main M is permanently connected to the metal portion of the other commutator through the cable *f*.

Suppose now that a car is coming along the line from left to right, and that the commutators are therefore revolv-

ing in the same direction as the hands of a watch. Suppose also that the stud S^1 is "alive," owing to the sectional main S M^2 of the commutator C^1 being connected to the main M at

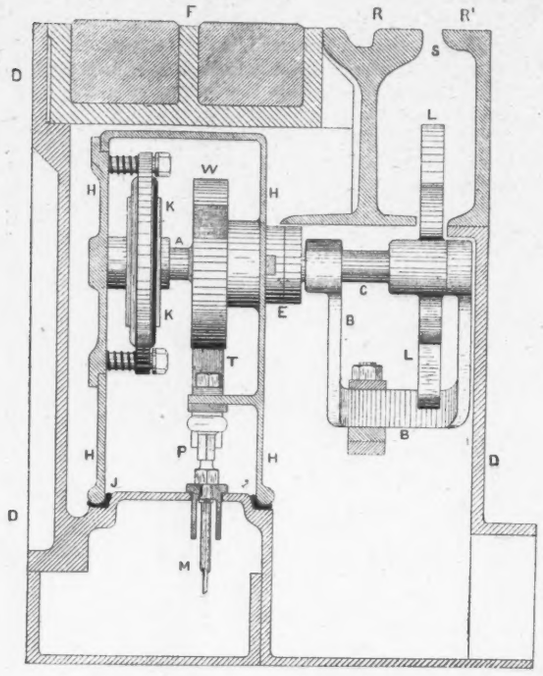
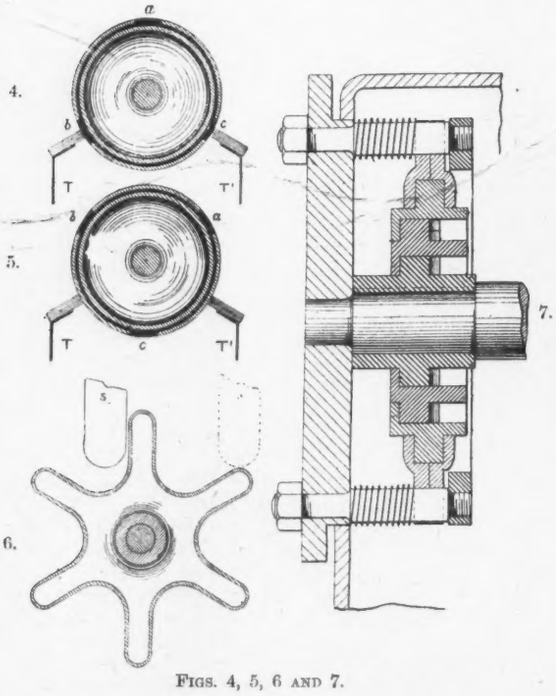


FIG. 3.

the previous box, not shown in the diagram. When the car has reached S^2, and is just about to leave S^1, the commutators C^1 and C^2, will be operated simultaneously by the striker, and will be caused to turn one-sixth of a revolution. The result of this will be to insulate sectional main S M^2 at *b*,



FIGS. 4, 5, 6 AND 7.

and thus to cut off the stud S^1. At the same time the contact *d* of the commutator C^2, which at present is insulated, will be connected to the main M through *f*, and will put the current on to the next sectional main S M^2. Following this up it will be seen to be already connected to the stud S^2 through the contact *b* of the commutator C^3. Thus the single movement of the commutators C^1 and C^2 has effected the double result of cutting off the stud S^1, and connecting the stud S^2. When the car reaches S^3, the commutators C^3 C^4 will be operated with the similar result of cutting off stud S^2, and connecting stud S^3; and so on all along the line.

When two strikers are employed on the car, the arrangement of conductors is simpler, and is shown in fig. 9.

R R are the rails, S^1 S^2, &c., are the studs. M is the main electrical conductor, and C^1 C^2 are the commutator switches. The action of these switches has already been explained with reference to figs. 4 and 5.

FIG. 8.

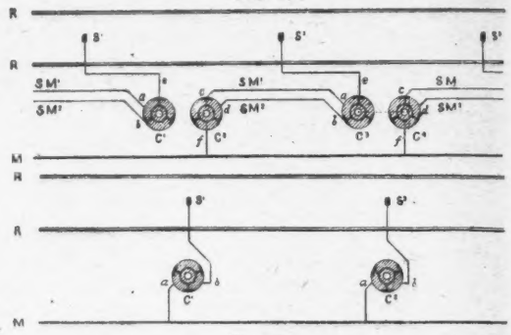


FIG. 9.

Fig. 10 is a cross-section of one of the studs, showing the manner in which the connection with the cable S from the switch is effected by means of a connector F and flexible cable G. The body, A, of the stud is covered with insulating material, H. The contact plate B is seen to be readily removable for renewal or examination.

From the foregoing description it will be seen that the system is very simple; it does not involve any important departure from the ordinary methods of track construction, and it may be applied to an existing track by setting up an

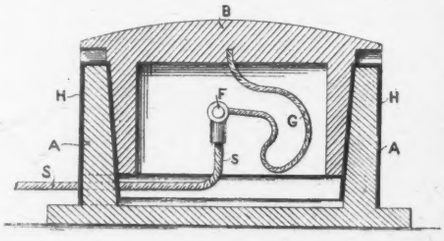


FIG. 10.

additional rail to form the slot, and, of course, bonding the old rails for the return circuit. The slot is too shallow to be called a conduit; it contains no conductors, and is unaffected by water. There is no difficulty in changing to the overhead system at the outskirts of a town, and if desired, a second row of studs, operated by the same switch gear, may be laid down, so as to dispense with the rails for the return circuit.

The question of cost is, of course, of the greatest interest; it is stated that the relative values of the capital outlay for the three systems named below are as follows:—

Overhead trolley	£5,000 to £6,000
Kingsland surface contact ...	6,500 to 7,500
Open conduit	10,000 to 12,000

The experimental track at Wolverhampton is to be inspected to-day by a number of gentlemen interested in electric traction, including the technical press; we therefore defer criticism of the system until next week.

Case Settled.—It is stated that the case of Robinson *v.* Blackheath, &c., Electric Light Company has been settled by the payment of £200 damages and costs by the company to the father of Arthur Robinson, the lad who was killed at their works by an electric shock in October last.

A NEW INDUCTION COIL.

A pair of very large induction coils have just been made by Messrs. Queen & Co., of Philadelphia, for the Japanese Government. They will give a 45 in. spark, and are to be used for wireless telegraphy. Nothing so large as this has been constructed since the famous Spottiswoode coil, made by Mr. Apps. The following table will show the difference in some essential details between the two coils, the figures being taken from a description of the new coil by Prof. Peckham

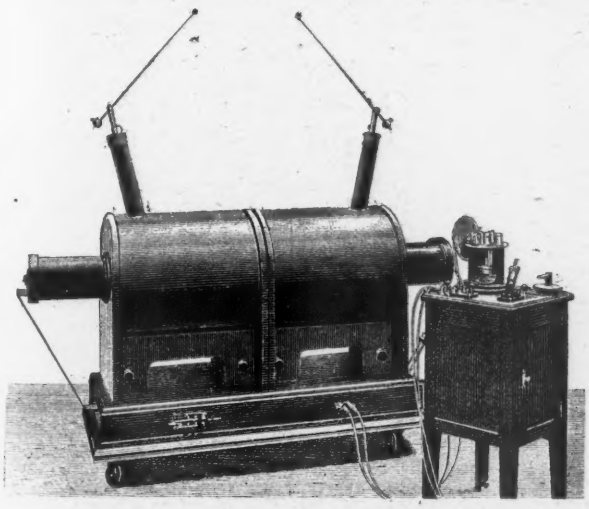
	Spottiswoode coil.	Queen & Co.'s coil.
Length of spark... ...	42½ inches.	45 inches.
Total length of coil ...	4 feet.	4 feet.
External diameter ...	20 inches.	15 inches.
Core of primary—		
Length...	44 inches.	48 inches.
Diameter	3·56 inches.	5 inches.
Weight	67 lbs.	200 lbs.
Secondary coil—		
Length	280 miles.	100 miles.
Battery	30 Grove cells.	12 secondary cells.

in the *Scientific American*. The core of the primary of the new coil is much larger in diameter than in the Spottiswoode coil. This enables the coil to give the same length of spark as the Spottiswoode coil, with only about one-third the length of wire in the secondary.

The general method of mounting can be readily seen from the illustration.

It will be seen that the secondary is divided in the centre, making two distinct and separate parts on separate spools. This is done for convenience in handling, each part being easily removable for transportation.

The form of the secondary is very unlike that of the Spottiswoode coil. The proper position and size of the coils of the secondary were carefully determined by experiment



Large Induction Coil.

and measurement of the magnetic flux. It will be observed that the iron core extends nearly a foot beyond the secondary spools.

The circuit breaker and condenser are placed in an auxiliary piece of apparatus seen to the right of the coil. The break is accomplished by an electro-motor moving very heavy pieces of platinum which separate under the surface of a liquid. The speed of the circuit breaker may be varied through wide limits. The condenser is divided so that its capacity can be adjusted. By connecting the centre of the secondary to the primary, the potential difference between the secondary and the primary cannot rise higher than half the spark length. The poles of the secondary are heavily insulated, and are enclosed in hard rubber tubes which extend to a safe distance above the coil.

The full length of spark (45 inches) is obtained when the coil is excited with a secondary battery of 25 volts, giving 20 amperes.

INTERIOR WIRING.

Mr. George A. Clark has drawn the attention of the Glasgow Local Section of the Institution of Electrical Engineers to the existing state of affairs in the wiring business in his paper on "Electric Wiring," and as it affords an interesting review of some of the practical difficulties in the way of the selection of a perfect or ideal method of wiring, and points out a few of the more serious defects, it should not pass unnoticed. The paper also suggests some remedies for these defects, and elicited in the discussion the opinions of such practical men as Prof. Baillie, Messrs. W. B. Sayers, McWhirter, Ward, H. B. Maxwell and Coats. We may present the more important suggestions made by the author and by those who debated his propositions as a whole. So much has been written about wiring that writers on the subject cannot avoid covering the same ground over and over again; the novelties introduced into the treatment of the subject coming from the more extended experience of those who deal with it.

That there is no intrinsic difference between the interior wiring of premises supplied by isolated or private plants and those taking supply from street mains is axiomic, but it is necessary to go further, and say that any divergence in practice should be rectified, as in time most premises now operating private plants will come over on the public supply. The newer systems employing metal sheathing or protection to the insulated conductors are better and safer than the old-fashioned, but still most general, wood-cased work. The protection metals afford requires to be modified in theory, and special precautions have to be embodied in practice when destructive fumes or gases are present, and these of a character attacking such metals as are used for conduits or sheathing.

No system or method of running conductors can be proof against defective material or careless workmanship. Faults are due to neglect of proper precautions to ensure safety. The selection of a system largely depends on the class and character of building to be wired; but after all is said the general opinion seems to be that the principle to be first thought of is the most suitable protection for the conductors. Some engineers contend that a draw-in system, good as it may be, is seldom a draw-out system.

Taking the four leading methods in vogue :—

a. Screwed tubes.
b. Simplex tubes.
c. Lead-covered twin cables.
d. Wood casing.

Their characteristics may be denoted by :—

1. Mechanical protection.
2. Watertightness.
3. Risk of damaging the insulation.
4. Electrical continuity.
5. Accessibility.
6. Cheapness.
7. Facility for extensions.
8. General applicability.
9. Chemical stability.

In the paper the arguments are generally :—

Class of protection.	For.	Against.	Remarks.
a. Screwed tubes ...	1, 2, 4.	3, 6, 7.	Difficult to connect to distribution boards; must be done well.
b. Simplex tubes ...	1, 6, 7.	2, 3, 4.	Cutting away an objection.
c. Lead-covered twin cables.	2, 4, 6, 7.	1.	Jointing a difficulty.
d. Wood casing.	6, 7.	1, 2.	Suitable only for surface work in dry places.

Accessibility involves the ready detection of bad work during erection, and, obviously, cheapness requires the system to be easily installed. Internal condensation may take place in a tube; the ventilation of Simplex tubes when laid is, perhaps, negligible; but, if desired, screwed tubes can be ventilated by drilling holes in them. Tubes require well insulated conductors to be drawn in (unless Mr. Bathurst has his way, and the insulation be placed on the inside of the tube instead of on the conductor). Tubes are oftentimes difficult to fix without considerable cutting away,

the Simplex being less difficult to manage than screwed gas barrel, as the jointing is easy and rapid. Lead-sheathed wires are readily run, they cannot suffer from internal condensation (if this be really a point to be considered), but they afford little mechanical protection to the insulation from nails, &c. As electrical conductivity of the metal sheathing or piping must be obtained, the jointing of tubes and of the lead covering has to be watched. Inferior work at the joints leads to a breaking of the continuity soon or later. The circuit fuse should protect sheathing against over-heating should it ever have to carry a large leakage current. Lead-covered conductors in metallic conduits seem to give the utmost security possible, but the double protection makes a job very costly. New work carried out with tubing, existing premises wired with lead-covered conductors, and surface work in dry places in casing is apparently the rule adopted by many architects and engineers. Mr. Clark has attempted to give good marks under each head to the different systems. This is apt to be misleading unless a given building is the subject of the investigation.

There is diversity of opinion as to joints. One engineer condemns pinching screws as liable to work loose, or to sheer the conductors: another objects to soldered joints as being delusive, and usually held together by a speck of solder. Use good mechanical joints properly clamped, avoid **T** joints, and there need be nothing but porcelain, uncut vulcanised rubber and iron on a job. The difficulty with **T** joints is to efficiently and permanently insulate them. Fittings should be made removable and be fixed on iron or metal back-blocks. The ideal method enables wood and sticky-stuff to be eliminated altogether, and everything is engineering finish and mechanical throughout.

Wiring rules should be standardised, says the author, and goes on to hint the M.E.A. might take on the task. To this the reply is made that nothing but pure "cussedness" prevents the Institution rules being now accepted without further delay. Fittings also should be standardised: then manufacturers could keep a stock instead of a museum, but municipal and company engineers must have some unanimity of opinion, first, as to what is safe and what is not. Ceiling-rose fuses are sometimes permitted and at other times condemned; inconsistencies regarding fuse-lengths and switch-cover material should give place to reasonable uniformity.

On the thorny question of consultants *v.* contractors we will not now venture. Certainly a responsible engineer will inspect work in progress and hesitate to specify makers unless he is convinced that his clients will only be safeguarded by one particular manufacture of lamps, or other accessory being fitted. Proper accommodation will be provided for cables and conduits and space given for boards and switches. It is, however, rather too much to suggest that the engineer's fee should provide retention money or pay for faults subsequently discovered. The engineer has not got it in his power to command success, he can only endeavour that the work shall deserve it.

Mr. Clark and Mr. Broadbent each have taken up valuable points in connection with wiring, and if the localising of the Institution's debates has done nought else, it has enabled vexed questions of detail to be ventilated which may be aptly treated at Glasgow and Newcastle, but would hardly suit Great George Street.

PROGRESS AND IMPROVEMENTS IN PATENTS.

By RANKIN KENNEDY.

The views of Mr. Siemens regarding patents may appear startling to many, but they may be taken as representative of the attitude of British manufacturers, assumed in the presence of protected improvements, and the thanks of the industrial world are due to Mr. Siemens for boldly proclaiming the views so generally held by those who are prohibited from the free use of the ideas and products of inventors.

It is perfectly well known that the last man to look at an improvement is the manufacturer most interested in the product or subject of the improvement; his feeling towards it is one of hatred, and rather than adopt an improvement his inclination is to block its appearance by every means in his power. There never was a greater fallacy preached by patent agents and authors on patent law than that an inventor should approach the manufacturers of the subject of the improvements with a view to the patents being taken up.

A powerful, wealthy patentee may compel attention to his improvements and exact royalties, but the ordinary type of patentee has to trust to speculators and company promoters; he has no other outlet for his products.

It is a remarkable fact also that all important inventions and improvements are, as a rule, made by outsiders; few improvements originate in the factory. There are, of course, some exceptions to this rule, in cases where a factory is run by the inventor of some special improved articles. But the employés in factories do not make improvements of any value.

Firms are known in this country who make it a business to note good specialities worked under a patent—usually abroad—and to lie in wait for the expiry of the patent and then begin manufacturing. This, of course, is perfectly within their rights, but it reveals a disposition which, to a large extent, accounts for the backward position we occupy as appliers of improvements.

It is usually from 10 to 15 years after an improvement is discovered before any recognition of it is legitimately made by manufacturers in this country, whereas on the Continent and in America improvements are eagerly seized upon and "worked for all they are worth" immediately they appear.

British manufacturers of electrical products have allowed the foreigner to march ahead rather than speculate on improvements. The Americans have secured the monopoly of electric tram plants, and a large share of the dynamo and motor business, simply by persistent improvements rapidly devised and immediately adopted. With the end in view of keeping to the front, foreign firms engage the best technical ability, and pay well for it, and if technical and inventive ability are combined in one person, especially do they value him the more.

In this country we often come across firms going into the dynamo and motor business advertising for a draughtsman able to do all the technical work on £2 or £3 a week. As a result the market here is full of obsolete "overtype" or "undertype" machines, whatever these terms signify. By-and-bye it is perceived that the foreigner is doing a good business with improved machines, the draughtsman is then called upon to get out designs for similarly improved machines, and presently we see some poor copies got out. The draughtsman is a valuable man, but he can never be made a successful substitute for the inventive expert in keeping a firm to the front in the march of improvements.

The first thing the British manufacturer has to learn is, that he must have expert technical assistance, if he is to be a leader and not merely a follower in the march of progress; and the second is, that he must seek for improvements and instantly make use of them, instead of trying to suppress them and to put off their adoption. No matter from what source improvements come, they must be recognised, paid for, and adopted.

Were it not for the fact that an inventor can obtain protection and deal with his improvements, the British manufacturer would jog along making the machines his grandfather designed, but the improver comes to the rescue. He does not beg the manufacturer as a favour to adopt his improvements, he offers them through other channels to the public, and ousts the manufacturer or compels him to go ahead and adopt the improvements. To argue that patents do not benefit manufacturers is utter nonsense.

Even with all the incentives to improve, and the advantages obtained by improving, so glaringly obvious, it is clear to everyone that we make little improvement. What then would be the state of affairs if no encouragement were given by Patent Law to outsiders making improvements; if our first state is bad, our last would be infinitely worse!

So far as British manufacturers are concerned, we should be still hauled about in old horse cars, and transmitting power by the dear old friends of our boyhood's days, the hoary "overtype."

The polyphase patents will soon expire; no doubt the progressive British manufacturer is discussing the state of affairs with his draughtsman, as after the usual interval of 10 years he wakes up to the fact that an improved machine may soon be freely adopted.

Mr. Ferranti voiced the feeling of every progressive engineer when referring to the rotary converters and motor generators upon which most of the gigantic schemes of transmission rely for converting high pressure alternating to low pressure continuous current.

"He agreed with Dr. Thompson that all this was not going to be permanent."

That remark might be applied to many things in electrical engineering; room for improvement there is plenty, and if the foreigner sees the room, he very soon finds the improvement to fill it, and so keeps ahead.

Finality in the design and construction of dynamo-electric machinery has not been reached, just yet; it must go through further evolution before it settles down to permanent lines, and those who by brains and money pull it through the stages of evolution, deserve the reward.

The Patent Law was made to encourage "new manufactures," and if the "old manufacturers" discourage them, then they must stand aside for "new manufacturers."

The Patent Laws, no doubt, require amendment, but even as they are, economists are agreed that, on the whole, they have resulted in a vast amount of good to the community, furthering progress in the arts and industries, and by encouraging competion, compelling lethargic old concerns to move with the times, or perish!

MEASURING PERMEABILITY AND ELECTRICAL ENERGY.

At the close of the session, after the problems connected with the distribution of electrical energy on a large scale have been tackled, the Institution of Electrical Engineers has settled down to discuss some of the means whereby such distribution may be measured, and the plant connected with its generation tested. Current, power and resistance measurement occupied the last meeting in April: on Thursday of last week the members had before them the simple and ingenious instrument devised by Messrs. C. G. Lamb and Miles Walker, for measuring the permeability of iron and steel, and a novel form of integrating wattmeter designed by Mr. Frank Holden. This latter instrument may be classed as an integrating ballistic wattmeter, and comes as a pleasant reminder that there are still some types of meters to be invented: that synchronous clocks, induction and commutator motors, and electrolytic meters, are not necessarily the only forms to which the engineer may have to give such attention as he can spare from the cares of business management, or a study of flue-gases and thermodynamic problems.

The Lamb-Walker permeameter may, for the sake of those who have not deeply read the paper of last Thursday, be compared to the old device of Foussereau for comparing resistances. A battery of many cells was joined to two resistances in series, and the intermediate junction of the resistances was taken through a galvanometer to a point on the battery, which gave no current through the bridge conductor. The resistances were in the ratio of the number of cells opposite to them. Similarly in the apparatus shown last Thursday, a magnetic circuit is formed of the test piece, an air-gap, and a yoke. On the test piece and round the air-gap are wound magnetising coils. At the junction of air-gap and test piece is fixed a magnetic needle. By adjusting the air-gap the reluctances are balanced so that the needle is not deflected; then the magneto-motive forces are proportional to the reluctances, and the value of the air-gap is read off a scale which can be calibrated empirically by the aid of standard test pieces.

Mr. Evershed reminded the members of Prof. Ewing's instrument, described to the Institution some time ago, which measured permeability inferentially by the force required detach a test piece. A better instrument was now forthcoming, it compared the reluctance of an unknown thing with the reluctance of such a definite thing as an air-gap; but other methods of varying the air-gap might be tried, such as moving the surfaces in parallel planes and thus extending the range enormously. The difficulty was to make an instrument for dealing with material in bulk and testing it in the condition in which it is received. Mr. Esson wanted something in a small box with a key at the bottom, such that by turning a wheel and pressing the key a reading giving the permeability could be obtained. The author of the paper, humorously remarking that Cambridge was not merely a place where dinners were shunted by a few lectures, said this form had been come to as the simplest. The range could be extended by having different windings on the two magnetising coils. It had not the accuracy of Ewing's bridge, but was simpler and more convenient in operation. All instruments so far tried had proved impracticable when it came to testing iron in bulk.

Mr. Evershed opened the discussion on Mr. Holden's paper, and congratulated the author upon the fulness of the data in it. Further details as to the effect of time were wanted. Considering meters generally, he thought the meter of the future would not be found to contain a clock. Years ago he had tried to make a ballistic galvanometer meter, but did not hit upon the idea of a hysteresis brake. The constancy of such a brake is a matter of experiment and observation. The meter took little electrical power, like all meters containing clocks, but how much man-power would be required to keep it right? He gave a funeral oration over all meters containing "feelers," but this meter apparently was of another type. He believed the Aron meter was successful because it was most perfectly made, and hoped competition would not lead to temptation to reduce the class of workmanship. Mr. Hammond recalled some of his early experiences at Eastbourne and elsewhere, and gave his opinion that during the first three months a meter was very trying to the consumer. The 2 per cent. starting load of the Holden meter was a great advance, but he wanted to know more about its accuracy throughout varying loads, and believed in the time test. He asked how the meter would work in damp cellars, and whether its upkeep and accuracy would be affected by such surroundings. Mr. Trotter pointed out the difficulty of testing such a meter unless the disc was arranged for reading by fractions of a revolution. One thing he was glad to see was the use of a true probability curve in an engineering paper. Prof. Ayrton showed that the Holden meter was an energy meter; this might be a disadvantage to the consumer if the supply pressure was raised and lamps burnt out, while the consumer had to pay the full value of the energy causing such breakages. He suggested fining the supply company automatically for such freaks of supply. He drew a fanciful picture of a sharp customer who dodged an intermittent integrating meter by timing his use of the supply, so as to take zero power at the periodical registrations of the counting mechanism. Mr. Crawley wanted to know if Foucault currents were not induced in the iron brake disc, and Mr. Albert Campbell suggested that the earth's field would have to be considered in fixing the meter, as at low loads it would affect the action of the suspended pressure coil.

Mr. Holden, in replying, was modest in his claims, but postponed replies to many of the questions for further practical experience with the meter. He answered some of the speakers as to matters in the paper, by directing their attention to the figures and curves in the description of the meter given therein.

LEGAL.

The National Telephone Company, Limited, *v.* the Mayor of Tunbridge Wells.

This case came before the Court of Appeal, composed of the Master of the Rolls and Lords Justices Vaughan Williams and Romer, on Thursday, the 2nd inst., on the appeal of the plaintiffs from the judgment of a Divisional Court composed of Justices Grantham and Channell, dated June 18th, 1900. Mr. Cripps, K.C., Mr. Roskill, and Mr. Casson appeared for the appellants, and Mr. Joseph Walton, K.C., Mr. Macmorran, K.C., and Mr. Boxall for the respondents.

Mr. Cripps, in opening the appellants' case, said that the case in the list, viz., the National Telephone Company, Limited, *v.* the Corporation of Huddersfield, practically raised the same point as the Tunbridge Wells case, but as the Divisional Court had heard the Tunbridge Wells case and delivered judgment on it, it was decided to take that appeal first. Before reading the special case he would put before their Lordships the point in dispute, and then call their Lordships' attention to the agreement and Acts of Parliament bearing on the subject. The National Telephone Company were claiming to put down certain wires and so on in connection with the supply of telephonic communication in the Tunbridge Wells Urban District. The District Council, however, objected to this, and said, "You cannot do this without our consent." Under the terms of a certain agreement which refers to certain Acts of Parliament the District Council have not got a right of absolute veto, but it was provided that if there was a difference of opinion the parties must go to arbitration. The plaintiff company went to his Honor, Judge Emden, as the arbitrator, and he decided that he had jurisdiction to entertain the matter, that it was a matter for arbitration, and that the District Council had not the right of absolute veto. The matter then came before the Divisional Court on a prohibition to prevent the County Court judge proceeding with the application before him on the ground that there was no matter for arbitration, and that the defendants had the right of absolute veto. The Divisional Court decided that the County Court judge was not the proper tribunal to determine any difference which had arisen between the parties. That was the whole point of the dispute between the plaintiffs and the defendants.

The Master of the Rolls asked if this case had anything to do with electrical cars?

Mr. Cripps replied that it had not.

The Master of the Rolls remarked that he was down at Kew Bridge a few days ago and everything was in a great mess. He was not surprised, after what he saw, that public bodies objected to them.

Mr. Cripps then referred to two deeds of 1884 and 1896 made between the Postmaster-General and the National Telephone Company, by which the company were authorised to work and use certain forms of telegraph for the purpose of transmitting telegrams within the borough of Tunbridge Wells. By a deed dated 1896, and made between the Corporation of Tunbridge Wells and the Telephone Company, the Corporation consented to the company exercising within the borough such powers as might from time to time be delegated by the Postmaster-General to the company in pursuance of Sec. 3 of the Telegraph Act, 1892. This deed went on to say, "It is expressly agreed that the consent contained in the preceding clause is given upon the following conditions: (1) Except as regards the work mentioned in the schedule, the company shall not exercise any of the powers conferred on the Postmaster-General by the Telegraph Acts, 1863 and 1878, in respect of which the consent of the Corporation is required under the said Acts, without obtaining the further consent in writing of the Corporation to be from time to time given to the specific works for the time being proposed to be carried out under such powers, it being intended that the general consent contained in the preceding clause is not to operate to relieve the company from the obligations of obtaining the particular consent of the Corporation to such specific work as required by and provided for in the said Acts." Clause 10 of this agreement contained a reference of all disputes to two arbitrators and an umpire. The company wished to open a new street and lay telephone wires not mentioned in the schedule to the last-mentioned deed, and applied for the consent of the Corporation. The Corporation refused, and the company contended that under Sec. 4 of the Telegraph Act, 1878, they had the right to refer the difference to the County Court judge.

Their Lordships, without calling upon counsel for the respondents, affirmed the decision of the Divisional Court, and dismissed the appeal with costs.

The decision in the above appeal governed the case of the National Telephone Company, Limited, *v.* the Corporation of Huddersfield, which raised practically the same point. The plaintiffs' appeal in this case also was dismissed with costs.

Brush Electrical Engineering Company *v.* the Governor of Malta.

The matter of an arbitration between the Brush Electrical Engineering Company, Limited, and the Governor of Malta came before a Divisional Court of King's Bench, consisting of Justices Kennedy and Phillimore, on Friday last, on a special case stated by the arbitrator for the opinion of the Court.

From the special case it appeared that differences having arisen between the Brush Electrical Engineering Company, Limited, and the Governor of Malta in respect of claims made against the latter under a contract of March 22nd, 1895, the matter was referred to Mr. E. Manville under the arbitration clause in the contract. The claimants undertook to execute certain works for the supply of electricity in Malta, and Sir W. H. Preece, K.C.B., acted as consulting engineer from time to time, certificates were given by him, and payments made for work done. On November 20th, 1897, the consulting engineer gave the claimants two final certificates, the first certifying the sum due to the claimants (being the final balance less one-fifth of the total amount for the contract price deducted therefrom, and the second certifying that the whole of the works had been completed, and had worked satisfactorily for six months from completion, and the other obligations of the claimants had been duly performed, and that the above mentioned one-fifth of the total amount of the contract price was then due to the claimants. In ascertaining the amounts so certified, the consulting engineer deducted from the total price of the work as determined by him the sum of £450 as damages for delays under the contract. The Governor of Malta, the respondent, had offered to pay the total amount certified by the engineer, less a sum of £1,100 (in addition to the £450 already deducted) which he claimed to be entitled to set off as liquidated damages for delay. On June 1st last year, the parties appeared before the arbitrator, when the claimants professed to give evidence in support of their claim for the total amount of the invoices sent by them to the engineer less certain deductions which they had allowed. In particular they proposed to give evidence to show that the engineer had not correctly estimated the value of additions and deductions in accordance with paragraph 35 of the contract. The respondent contended that such evidence was not admissible. On his part the respondent proposed to give evidence to show that he was entitled to deduct the further sum of £1,100 as liquidated damages for delay, as provided under the contract. The claimants contended that such evidence was not admissible. The questions of law for the opinion of the Court were: (1) Whether the engineer's certificate was a condition precedent to the claimants' right to recover under the contract; (2) whether the engineer's certificate was binding and conclusive between the parties with regard to the points raised in the statement; (3) whether the engineer's certificate was binding and conclusive between the parties with regard to the amount due to the claimants, apart from the question of damages for delay; (4) whether the engineer's certificate was binding and conclusive between the parties with regard to the amount due to the respondent in respect of damages for delay.

Mr. Carver, K.C., Mr. Llewelyn Davies, and Mr. Trevor Bigham appeared for the Brush Electrical Company, and Mr. Pickford, K.C., and Mr. J. Eldon Bankes, K.C., for the respondent, the arguments being of considerable duration.

The Court reserved judgment.

Crow *v.* the Board of Works for the District of Whitechapel.

In a Divisional Court of King's Bench, composed of Justices Grantham, Kennedy and Darling, on Friday, the 3rd inst., judgment was delivered in the case of Crow *v.* the Board of Works for the District of Whitechapel on the appeal of the defendants from a decision of Mr. Dickinson, the magistrate sitting at the Thames Police Court, in June last. The case was argued before Justices Kennedy and Darling last December, but their Lordships then disagreed, and the case was accordingly re-heard on April 27th before an additional judge—Mr. Justice Grantham—and judgment was then reserved.

A summons was taken out by Mr. Crow, the district surveyor, against the defendants, the local authority within the meaning of the Electric Lighting Acts, 1882 and 1888, for the district, alleging that the defendants had not given him notice under Sec. 145 of the London Building Act, 1894, before commencing the construction of a number of boxes, or inspection chambers, under the streets in the district for the purpose of electric lighting. The magistrate found, as a fact, that the boxes so constructed "were buildings, structures or works" within the meaning of Sec. 145 of the London Building Act, 1894, and having regard to Secs. 72, 201 and 203 of the said Act, he held that the provisions of Sec. 145 were not inconsistent with the provisions in the Special Act, and imposed on the defendants the nominal penalty of 1s., and ordered them to pay £10 10s. costs. From this decision the defendants appealed.

Mr. Justice Grantham, in the course of his judgment, said he thought that the magistrate had come to a proper decision on the matter. The question was whether the London Building Act of 1894 revoked or altered by the construction of general words the Electric Lighting Acts of 1882 and 1888. Was the language of the former Act where it directed that notice should be given to the district surveyor before commencing work, inconsistent with the powers given to the appellants by the Electric Powers Acts, 1882 and 1888, and the Provisional Order of 1892, for the supply of electricity to their district? In his Lordship's judgment it was not. It was true that the appellants had power given them to provide electricity for their district, and that they were obliged to lay the scheme they proposed to adopt and the plans by which they proposed to give effect to it before the Postmaster-General and the County Council, but neither one body nor the other was bound to see how the work was done. The necessity of the sanction of the Postmaster-General was for the purpose of enabling him to see that the interests of the Post Office were not prejudiced, and not in any way to provide for supervision of the work done. In the same way the notice to the London County Council as the superior municipal authority of the district was desirable, if not necessary, in order that the Council might be cognisant of what was going to be done in one of the districts included in its municipal area on such an important matter as the provision of electricity. Not one of these notices, however, had reference to any control of the way in which the work was to be done or as to the compulsory supervision of the work during its construction, but Sec. 145 of the London Building Act, 1894, required such a notice to be given to the district surveyor as would enable him to know when the work was to be commenced, and the details of the proposed work, so that he could survey the work when commenced and see that the details were carried out in conformity with any by-laws that might have been passed in reference to such buildings. He did not see how it could be said that it was inconsistent with or contradictory to the, general provisions of the Electric Lighting Acts under which the appellants obtained their authority

to provide the electricity for their district. For these reasons his judgment must be for the respondent.

Mr. Justice KENNEDY concurred, and

Mr. Justice GRANTHAM added that although Mr. Justice Darling did not see his way to agree with the judgment of the Court, he was at the same time unwilling to differ.

The appeal was accordingly dismissed with costs.

ATKINS & APPLEGARTH *v.* CASTNER-KELLNER ALKALI COMPANY, LIMITED.

THIS case came on for trial on Thursday last week before Mr. Justice Buckley in the Chancery Division of the High Court of Justice. The plaintiffs' claim was (1) for an injunction to restrain the defendants, their servants and agents, from infringing the plaintiffs' Letters Patent numbered 20,768, and dated December 19th, 1890; (2) for damages for the infringement of the said Letters Patent, or alternatively that an account may be taken of all the products made by any process in infringement of the said patents which have been made, sold, or used by the defendants, and also of the proceeds of sale and profits made by the defendants by reason of such manufacture, sale, or user for payment by them to the plaintiffs of the amount so found; (3) delivery up to the plaintiffs or destruction of all machines, apparatus, or appliances in the possession of the defendants made in infringement of the plaintiffs' said patent; (4) costs. The statement of claim set forth that the defendant company had infringed the plaintiffs' patent, No. 20,768, granted for the term of 14 years from December 19th, 1890, for an invention for improved means and apparatus for separating alkaline and earthy metals and other products from the salts of such metals, or from other substances contained therein. The patent is still valid and subsisting. Such means consist in subjecting a solution of such salts to electrolysis in electrolytic apparatus, the cathode pole of which is composed more or less of a flowing or moving surface or body of mercury whereby the metal, or hydrate of the metal, can, in the manner described in the specification, be continuously removed, and the counter electromotive force set up at the cathode by the metal and the hydrogen is substantially reduced. The plaintiffs represent that they were the first and true inventors of the invention, and that the defendants were manufacturing, using and selling caustic soda, or sodium hydrate, and other products produced under a process or processes which are infringements of the patents. Particulars of breaches of the plaintiffs' letters patent are given. These set forth that the defendant company, by their solicitors, on March 20th, 1897, admitted in writing addressed to the plaintiffs' solicitor, that they had commenced to work the Castner-Kellner process. This is a process whereby caustic soda and other products are produced by the electrical decomposition of alkaline salts, which the defendants claim to be protected under certain letters patent taken out by Hamilton Young Castner, No. 16,046 of 1892, and No. 10,584 of 1893, and by Chas. Kellner, No. 17,169 of 1892, but which the plaintiffs aver have been anticipated by their invention. Plaintiffs are unable to state by which of the said patents, or by what combination of the said patents or any of them, the process called by the defendants the Castner-Kellner process is claimed to be covered, or what the process as used exactly is, but in any case they say that the Castner-Kellner process is anticipated by their own letters patent. The defendant company (plaintiffs further explain in their pleadings) are the owners of the three patents mentioned, and have erected and fitted up large works at Weston Point in the county of Cheshire, and have been continuously since the completion of these works, and still are producing caustic soda and other products for commercial purposes by use of the Castner-Kellner process, and selling and dealing with the same. In such process plaintiffs say the defendants have been using machinery, apparatus and appliances covered by their (plaintiffs) patent. On the other hand, defendants, besides denying that they have infringed the Letters Patent in question, relied in support of their defence on the following objections to the validity of the patent:—(1) That the alleged invention was not new, or the proper subject matter of the letters patent having regard to the state of public knowledge at the date of the patent; (2) That the alleged invention was not of any public utility; (3) That the specification did not sufficiently distinguish which of the matters therein described the plaintiffs claimed to have invented, and which they admitted to be old; (4) The specification was insufficient and misleading, inasmuch as it did not describe process and apparatus whereby alkaline and earthy metals may be separated from the salts of such metals or from other substances containing them. (5) That the alleged invention as to so much of it as consists of a moving or flowing mercury cathode was previously to the date of the letters patent published within this realm in and by a publication in the following manner:—By the provisional specification of Andre Leopold Nolf for apparatus for producing chlorine gas and metallic sodium from chloride of sodium, dated September 12th, 1882, and numbered 4,349. By a United States patent specification for a process of and apparatus for obtaining chlorine and sodium granted to Andre Leopold Nolf, dated October 15th, 1882, and numbered 271,906, and duly placed upon the shelves of the Patent Office Library on or about August 15th, 1884. By the provisional and complete specifications for a process for the production of ferricyanides of potassium, sodium and ammonium by electrolysis, upon which British letters patent were granted to Camille Petri, dated June 2nd, 1886, numbered 7,426. By the provisional and complete specification for improvements in the amalgamation of gold and other ores and in apparatus employed therein, upon which British letters patent were granted to Arthur Edward Donkin, dated June 6th, 1888, and numbered 8,303. The whole of these specifications defendants relied upon.

Mr. T. Terrell, K.C., Mr. Astbury, K.C., Mr. MacConkey, and Mr. J. H. Gray (instructed by Messrs. Van Sandan & Co., agents for Messrs. Wright, Becket & Co.) appeared for the plaintiffs. Mr. Moulton, K.C., Mr. Bousfield, K.C., Mr. J. C. Graham, and Mr. A. J. Walter (instructed by Messrs. Blaker & Hawes) appeared for the respondents.

Mr. T. TERRELL, K.C., in opening the case for the plaintiffs, said that the invention was one for decomposing salt by means of electric current. It had long been known that if you had a combination of two substances, such as chlorine and sodium, or hydrogen and oxygen, or any other similar elements which produced a salt, and if you passed an electrical current through the solution of the salt you decomposed it. It was particularly important that his Lordship should have as accurate a knowledge as possible of the very beginning of the science to which the case related. Mr. Terrell then gave a practical illustration in Court of what he had explained. If in his illustration he had used a solution of common salt instead of water, at one pole there would have been developed the metal sodium, and at the other pole chlorine gas. Atkins & Applegarth's apparatus obtained a continuous flow of chlorine on one side and a continuous deposition of sodium on the other. So long ago as Sir Humphrey Davy's time it was ascertained by electrolysing chloride of sodium in this way you could get metallic sodium, but nothing was done with it, because, first of all, the sources of electrical energy had not been developed in such a way that electrical energy could be devoted to such a purpose with economic results, but also for this reason, that the moment the sodium was set free as metallic sodium, being in a solution which contained water, it itself in its turn decomposed the water and so became soda and gave out hydrogen. Although they knew perfectly well they could decompose chloride of sodium by means of an electric current, getting sodium and chlorine, it was a very great problem how they were to use that in such a way as to be able to separate the soda from the chloride solution. Many years ago chemists would have laughed if they had been told that the process for making common soda was first a process of making sodium and then oxidising the sodium. Still, that was what it came to, and that was entirely due to the fact that the mercury would absorb the sodium, form an amalgam, and protect it from the action of the water. Great difficulties were in the way of carrying that into practice. It was obvious that in making a substance so cheap as common soda by electricity economy of electrical energy was one of the first considerations, and if they wanted to make the process commercially successful they must economise their electrical energy. Then mercury was a very expensive article, worth about 3s. a lb., and when you were going to use an article worth 3s. a lb. in the manufacture of an article worth 1d. a lb., it was obvious you must be economical in the use of the dearer article. It was necessary, therefore, to devise a plan which would be economical of mercury. Then again, you had to protect your anode from being attacked, and you had to take care that the evolution of chlorine was arranged in such a manner that your apparatus was not destroyed. Then you had to get the chlorine away. A great many attempts were made to bring the theory to commercial use; one of the greatest difficulties was wasted energy. When your mercury absorbed a certain amount of sodium, there immediately began to be set up more or less local action between the mercury and the sodium, and the water or liquid in which it was. That set up what was called counter-electromotive force. You had the current going to do the decomposition, travelling from the anode to the cathode, but immediately it operated and made sodium, you began to get sodium trying to be decomposed in the electrolyte, and setting up a counter-electromotive force which was negative and neutralising the current doing the work. That was one difficult thing. Then if it did decompose the water, you got no longer a pure solution of chloride of sodium, but a solution of chloride of sodium and caustic soda, and that caused an enormous waste of electrical energy. Then if you got too much sodium into your mercury, your soda and mercury amalgam got solid, and you could not work it any more. It ceased to operate. This is what the plaintiffs did. They said first of all you must have a very weak amalgam formed, and he (counsel) thought that in actual practice they found that ·2 per cent. of sodium was the most that you could usefully get into the mercury. Then the next thing was to get rid of the electromotive force, and to do that you had to keep your mercury flowing all the time it was absorbing sodium; so that the mercury, when presented to the electrical action, should always be weak in sodium, and should get taken away from the electrical action as strong as possible in sodium. He thought his Lordship would have established in evidence that the counter-electromotive force increased enormously with the increased richness of the sodium in the mercury. So what the plaintiffs said was that you must get your body of mercury brought into the operative part of your apparatus perfectly free of sodium, and during the whole time it is absorbing sodium you must make it move, and the moment it is rich enough in sodium, take it away, and you must not let it touch the electrical energy a moment. By that they got rid of the counter electromotive force. The learned counsel then read Atkins and Applegarth's complete specification.

At this stage the hearing was adjourned till Friday.

On the hearing being resumed on Friday last week, Mr. TERRELL resumed his opening statement. After pointing out briefly the objections to the plaintiffs' case, he explained that the previous case which had been before the Court, was an action by the Castner-

Kellner Company against the Commercial Development Corporation, the latter company being practically the plaintiffs in the present case. That action was against his clients for an infringement of a Kellner patent of 1894, No. 2,259. His clients lost the case before Mr. Justice Bigham, but the Court of Appeal and the House of Lords held that there was disconformity in the patents. Mr. Terrell then described the Castner patent of 1892, dealt with in the present action. He hoped that when his Lordship had heard the evidence, he would come to the conclusion that the defendants' objections to the plaintiffs' patent failed, and that this patent had been infringed.

Mr. Matthew Atkinson Adam, examined by Mr. Astbury, said he was in partnership with Mr. Dugald Clerk, was a B.Sc. of Glasgow University, Associate of the Institutions of Civil and Electrical Engineers, and had made a special study of the electro-chemical industry. Part of his knowledge was gained under Lord Kelvin. He had carefully examined and considered the plaintiffs' specification. The production of caustic soda by electrolysis and the user of the mercury cathode was not in commercial use at the date of the plaintiffs' patent. No apparatus with a mercury cathode had been brought to his attention by which caustic soda could be produced electrically with a mercury cathode before the date of the plaintiffs' patent. The fact of using electrolysis on chloride of sodium was well known before the date of the plaintiffs' patent. The fact that you could use mercury as a cathode was equally well known as a scientific fact. Caustic soda was matter which was sold by the ton, and it was of the greatest importance, to make it commercially profitable, that the electrical energy used should be small, and that the mercury should be used economically. There were great difficulties in the employment of mercury cathodes, because mercury was very expensive. If you had to have large quantities of mercury in the production of a cheap article like caustic soda, then the capital invested would be out of all proportion to the output. With regard to the electromotive force necessary to produce electrolysis, the witness said that unless the electromotive force was kept down to the utmost limit there was a great waste of electrical energy. First of all, if you did not get your amalgam away directly it was formed you had back electromotive force. Secondly, you got caustic soda formed in the electrolytic solution. The anodes in the plaintiffs' apparatus were formed of carbon rods. The fact of decomposition of soda on the anodes tended to make them weak, and they would not last long. In his view the plaintiffs' apparatus, which worked by means of a thin continuous flowing mercury cathode, solved the difficulties which existed at the date of the specification in the commercial production of caustic soda.

Mr. Astbury: Supposing you put mercury containing sodium into a cell with water and decomposed your sodium out of the mercury, does the mercury become free again and capable of being used again in the same process?—Yes.

The mercury can be treated substantially without waste?—Yes.

Examination continued: He considered that the plaintiffs' specification clearly and distinctly described the process and the means by which they intended to carry it out. He had seen the model made by Mr. Bevan actually working in accordance with the directions contained in the specification, and it worked successfully. He had seen it successfully producing caustic soda. In his opinion the rocking process which the defendants used acted in accordance with the directions and in the manner described, and pointed out by Atkins and Applegarth. There was no doubt in his opinion that the apparatus used by the defendants using a flowing or moving mercury cathode to do the work, did it in exactly the same way as was described in the plaintiffs' specification.

Mr. Astbury: Now as to the back electromotive force. Do you know of any apparatus prior to the date of the plaintiffs' specification in which a mercury cathode was used whereby the back electromotive force was avoided as in the case of the plaintiffs' specification?—No.

Secondly, is the saturation by caustic soda of the electrolyte avoided by the plaintiffs' invention?—Yes.

Do you know of any apparatus before the date of the plaintiffs' specification in which that was avoided?—No.

Thirdly, is the loss of electrical power also avoided in the plaintiffs' apparatus?—Yes.

Do you know of any apparatus using a mercury cathode in which that was avoided at that date?—No.

Fourthly, does the plaintiffs' apparatus make use of the whole of the mercury used for the purpose of drawing out the sodium from the electrolyte?—Yes.

Is the superficial area of mercury in the plaintiffs' apparatus very large compared with the bulk of mercury used?—Yes.

Was that the case in any prior apparatus that you know of?—No.

Fifthly, are the anodes in the plaintiffs' apparatus protected from destruction by reason of the non-decomposition of caustic soda in the electrolyte?—Yes.

Do you know of any apparatus before the plaintiffs in which that occurred?—No.

In the next place, are there adequate means used in the plaintiffs' apparatus for keeping up the strength of the electrolyte?—Yes.

And, lastly, are the electric forces in the plaintiffs' patent made as effective as it was possible to make them in this process?—Yes.

Was there any other apparatus prior to this date in which that occurred?—No.

Examination continued: He had read the four so-called anticipations, viz., the two of Nolf, Petri and Donkin. He did not find any indication of the plaintiffs' invention explained in any of them.

Is the problem which the plaintiffs' apparatus solved present in either Petri, Donkin or Nolf?—It was not. Nolf was very far away from the plaintiffs' apparatus.

Cross-examined by Mr. Fletcher Moulton: If a mercury cathode was not used the soda was formed in a salt solution. That was very bad, and what was most wanted to be avoided. It could not be avoided altogether. If a mercury cathode was not used it produced caustic soda, but produced it in conjunction with a mixture of salt—a great commercial drawback. Atkins and Applegarth's was a better method commercially. It was a method by which it could be got better and cheaper. He had never seen the apparatus in question worked before this trial, nor had he seen fig. 5 being worked. He was quite satisfied that they could be worked. So far as he knew, none of the apparatus described in plaintiffs' specification was ever worked commercially.

Questioned as to Nolf, the Witness said that from the description given in the specification, there was no idea of working the apparatus commercially. There was nothing in Nolf that was not perfectly well known in 1883 or 1890, in a sense. He showed the fact that you could electrolyse sodium in this way. His contention was that Nolf's was not a practical working method for a commercial purpose. The electromotive force used by Nolf, he should say, was about 6 volts, but perhaps 8 or 10. In Nolf you could keep the mercury fluid, but you would require to draw off almost immediately. He had never worked Nolf down to the present day; he had never used any apparatus which ever used a film of mercury as a cathode for commercial use. If they passed mercury over copper, it attacked the surface. In the amalgam they got a certain amount of copper. If you let the mercury flow over iron, there would be a considerable proportion not covered, because mercury would not amalgamate with iron. The moment any portion of the iron surface became bare, they would have a fall of electromotive force, and that would be due to the failure of the surface, but not to the failure of the apparatus. Nolf endeavoured to get the electromotive force while his mercury was in the course of getting rich.

What is there to keep the richness of the film in Applegarth lower than the richness of the mercury in Nolf?—He says he wants a flowing mercury cathode.

In fig. 5 what is there to keep the richness of the thin film of mercury less than the richness of the mercury in Nolf, who tells you not to make it too rich?—Nothing but the rotation of the band.

Further cross-examined, Witness said Nolf did not stir the mercury. He stirred the electrolyte.

You cannot show me any words in the plaintiffs' specification which warn against richness of amalgam?—Nothing except that the mercury is to be circulated, and to be continuously circulated. The amalgam is removed from the sphere of action. That is his idea to my mind.

Where is there anything about continuously removing it? Everyone knows you have to remove it?—The essence of his idea is the removing of the amalgam from the salt continuously.

You have told us that the back electromotive force is created by the richness of the amalgam?—Yes, but you have to carry that amalgam off, and plaintiffs' idea was that that amalgam was carried off.

But plaintiffs' idea was to carry off the amalgam from time to time before it got too rich?—He never got anything but the surface amalgam. Nolf's idea was to electrolyse the amalgam on to a surface of passive mercury where it would not be disturbed at all.

I put it to you that fig. 5 having a thin band of copper—so thin that it was flexible—dipping into mercury and having sodium amalgam deposited on it would rot so that it would not work. Is not that so?—That may be.

The mercury amalgam would rot the copper?—Through time. It is a question of time how long it would last.

I put it to you that it would not stand industrial work for a day?—I cannot say. That depends upon how it is arranged upon the diameter of the poles over which you bend it. That is one factor that will affect it, because it is bending over the copper while in contact with the mercury, which will facilitate the rotting, and if you choose very small poles, no doubt it will rot fast.

Look at Claim 1. That claim says: "The cathode pole, which is composed more or less of a flowing or moving surface or body of mercury."—They thought so; it is more or less flowing.

It cannot be more or less flowing; "composed more or less of a flowing" is the expression used?—Yes.

In other words, it contemplates part of the cathode not being this flowing surface of mercury?

Mr. Astbury: I submit that this is a question for your Lordship.

Mr. Justice Buckley: This is something pointed to on the specification, and I think it is a very proper question.

Mr. Moulton, continuing cross-examination: If the surface is not amalgamated, it would be very difficult to make the mercury always cover the surface if it was flowing in a thin film?—It depends on the thickness of the film entirely.

Now let me turn to the anticipations, and take Donkin. First sodium amalgam was very well known at this date, was it not?—Yes.

As a matter of fact, weak sodium amalgam decomposes very slowly?—Yes.

I put it to you that the real difficulty of applying this electrolytic process had nothing to do with the parts on which Atkins and Applegarth rely. The difficulty was that the decomposition of the amalgam went on so slowly?—I do not think so. I think it was perfectly well known that that could be overcome in a separate vessel. Electrically, everybody knew that the sodium dissolved in mercury was exactly like copper in an electrolyte, and could be electrolysed out very rapidly. There is no difficulty about that. It was perfectly common knowledge at the time that that could be done.

I put it to you that there is no suggestion before the Castner patent of a method of getting sodium out of mercury?—I do not

think so. I know of no public knowledge, except by heating it Of course, with a hot solution you can get it out pretty quickly.

If it is weak it is difficult to get it out?—It was perfectly well known. I knew myself at that date that a sodium lamalgam decomposed was exactly the equivalent of copper in an electrolyte. It could be used in a battery as zinc is used in a battery. It is perfectly well known that zinc dissolves in sulphuric acid and gives off an electric current.

I am putting it to you as a fact that the only difficulty in the use of mercury at all for this purpose was that there was not a convenient way of getting the amalgam out unless it was very strong?—No, I do not agree with that.

Donkin says, "My invention is intended for the production of a constant supply of an amalgam of sodium and quicksilver directly in or in contact with the quicksilver used for the amalgamation. It is well known that an alloy of quicksilver and sodium has a greater affinity for gold and silver, and better resists the action of base metallic oxides or sulphides and impurities in the ore than quicksilver alone." This is a patent for producing sodium amalgam from chloride of sodium?—Yes.

Now Atkins and Applegarth's patent does exactly the same thing, and no more?—I think he does do more.

What more?—He does it in such a way as to economise his solutions.

I am not talking about which does it the best way. I am only saying that the object of the two is to produce sodium amalgam?—The problems before the two are quite different.

Atkins and Applegarth's patent ends by producing sodium amalgam?—He describes how to produce sodium amalgam, that is one of the objects, and in such a way that it is reasonably economical.

Let me see how Donkin does it. "I use an electrolytic cell of some material incapable of conducting electricity, and which is not attacked by chlorine or caustic soda, and place in the bottom of it the cathode consisting of a layer of quicksilver; above the quicksilver I place a saturated solution of chloride of sodium in water, and in this solution I hang the anode of carbon."—Yes.

By making holes and fixing pipes in the side of the cell below the upper surface of the quicksilver, I can directly connect the main body of it to the quicksilver in an amalgamator, amalgamating pan, or settler, or other form of apparatus for the amalgamation of gold or silver or for the saving of the amalgam or quicksilver. And I cause a circulation of the quicksilver to and from the cell and the amalgamating device by means of gravity or by a suitable pump or otherwise?—Yes.

Now, what he intends to do is to circulate the mercury of his cathode, drawing it off into his amalgamator?—Yes, and he intends to have such a thickness or body of mercury in the bottom of his pan that he can put in two pipes to let in mercury and draw off the mercury at different levels, so he is intending to have a considerable body of mercury at the bottom.

If you want to get any amalgam and therefore work it at a rate to carry off any of the amalgam it will draw from all parts?—No doubt you will get some of the amalgam, but you will have a surface there which is practically the surface into which the amalgam is being deposited and that surface is not being changed in the sense of Atkins and Applegarth's patent at all.

I understand your objection to Donkin to be that the surface is not being continually changed in the manner that Atkins and Applegarth's does?—Yes, and therefore is not a moving cathode in that sense.

Now in Petri's case you deposit in the mercury an equivalent of sodium or of potassium which happens to be the instance given, just as in the other case you deposit an equivalent of sodium, the difference being that in the one case you leave ferri-cyanide and in the other case you leave chlorine?—Yes.

But so far the electrolytic operation is the same?—Yes, except that here you have the mercury against the porous partition.

Further cross-examined, WITNESS said that Petri's patent was not a moving mercury cathode in the sense of Atkins and Applegarth at all.

(To be continued.)

PARLIAMENTARY COMMITTEES.

CALEDONIAN ELECTRIC POWER BILL.

AT the resumed sitting of this Committee last week, Mr. J. SWINBURNE, C.E., was examined at some length by Mr. BALFOUR BROWNE, on behalf of the promoters, in respect to the engineering features of the scheme. Mr. Swinburne gave it as his opinion that the scheme of the Bill was well designed, and the sites for the generating and supply stations well planned. He considered that they were better placed than were the stations in the Clyde scheme. The importance and the economical advantages of getting a good load were becoming better understood, and therefore where possible, it was essential to embrace a large area of supply, so as to get as large a consumption as possible. Of course, a local authority might prefer to do its own lighting, but he should say that it would be more profitable for them to take their supply in bulk from a large company. In that case they would take no risk, and would be saved the capital expenditure of putting down generating plant. He should say that the chief opening for this company would be in the supply of power for which there was a large demand in the district proposed to be served.

The CHAIRMAN at this point said the Committee had decided that after the evidence had been finished on behalf of the present Bill, they would hear the case of the Clyde Valley Bill, and after that would take the evidence of the local authorities in opposition. That would save time, as the object of the local authorities was apparently to oppose both Bills. He must also say that the impression made upon the Committee by the evidence so far was that the estimates concerning the necessary expenditure had been very vague.

Mr. RENSHAW, M.P., Sir JOHN STIRLING MAXWELL, M.P., and other local witnesses having given evidence in favour of the Bill, the case for the Caledonian Company was closed, and the Committee proceeded to take evidence on behalf of the Clyde Valley Bill.

CLYDE VALLEY ELECTRICAL POWER BILL.

SIR DAVID RICHMOND, Chairman of David Richmond & Co., tube manufacturers, Glasgow and Govan, in reply to Mr. WILSON, K.C., said that at present his company were using steam power, but were of opinion that it would be a great advantage to have electrical energy for their works. The burgh of Govan were not ready to give a large supply such as they required, and besides that, the price they charged for electricity for power purposes was prohibitive. He did not think that a small burgh like Govan should embark upon a large scheme for supplying electrical power, but the case of course was different with a large city like Glasgow. He was one of the promoters of the Clyde Valley scheme, and having very carefully considered the proposed area of supply, he did not think it could have been better selected. He had pledged his money to the scheme because he thought it desirable in the interests of the locality as well as for the use of his firm. As a matter of fact, nearly all the promoters were in the same position as himself, being large local employers of labour with extensive works all over the area of supply. He considered the proposed generating stations to be admirably suited for their purpose. He was not antagonistic to the Caledonian Bill, beyond preferring the Bill of the Clyde Valley, of which he was one of the promoters.

In cross-examination, WITNESS said he should say there were more manufacturers in the area of supply of the Clyde Valley Bill than in that of the Caledonian Company.

Evidence having been given by local witnesses in support of the scheme,

Mr. ROBERT ROBERTSON, C.E., of Glasgow, the engineer to the Bill, described in detail the area of supply covered by the Clyde scheme. He said that generally speaking the scheme was modelled on the South Wales Bill, and in that respect it was very similar to the Caledonian scheme. The area of supply covered 732 square miles, including Glasgow, and there were some 1,200 manufacturing works who might be expected to use electrical power if it could be obtained cheaply. The promoters had entered into a provisional agreement with Lord Hamilton of Dalziel for land for the proposed generating station at Motherwell, and also into a similar agreement with Mr. Spiers, of Elderslie, for the proposed generating station at Yoker. Lord Hamilton was one of the promoters, his Lordship being of opinion that it would benefit the district and develop his property. Examined as to the method of supply to be adopted, Witness said that all his calculations with regard to the scheme had been based upon a supply by the multiphase alternating current system. That was a system which was very largely used on the Continent and in America, and he was convinced that it was the best system to be adopted for the distribution of power on a large scale. It was a system suitable for both power and lighting, but in the event of a local authority taking a supply from the company in bulk, and using it for lighting purposes and also largely for power, he thought it would be advisable and possible to give a supply for power purposes by the alternating current system, and for lighting purposes a separate supply transformed into a continuous current by motor-generators. The generating stations had been so placed so as to be coupled up with a view to a small interchange of the diversity factor, and also to one station helping another in the event of a breakdown. Witness then gave particulars as to estimates which he had prepared for the promoters of the scheme in conjunction with Sir W. Preece and Major Cardew. The capital they proposed to raise was, he said, £900,000, with borrowing powers for a further £300,000. They proposed to erect two stations of 10,000 KW., and one of 5,000 KW., with a voltage of 10,000. The cost of cables would be £75,000, and the transformers would cost £105,000. If they sold 43,800,000 Board of Trade units per annum at the average price of 1d. per unit, there would be a profit of 5 per cent. on the capital. It was not expected that for a considerable time to come it would be possible to sell at an average price of 1d. per unit, but with such a large company that should be possible in time.

Replying to Mr. BALFOUR BROWNE, WITNESS said that his estimates were based on information obtained from the working of similar stations in America. So far as he knew, that was the only place where they had such large stations as were proposed to be set up under the Bill. They had never had any intention of supplying within the boundary of Glasgow, but it was included in the area of supply so that the company might be in the position, in the event of Glasgow coming and asking for a supply of energy for any outlying portion of the city, of having the authority of Parliament to give such a supply. They had not taken Glasgow out of the Bill, but had come to terms that none of the purposes of the Bill should be operative as regarded that city without the consent of the Corporation in writing.

Replying to Mr. BLENNERHASSETT, K.C., WITNESS said they had never contemplated supplying Glasgow, because that city was already in possession of a large system of electric generation, capable of supplying users of power on a large scale.

In further cross-examination, Witness said he felt confident that the company would be able to supply power at a much cheaper rate than the small local authorities who were opposing the Bill. He was aware that Glasgow was supplying at less than 1½d. per unit, and it might be that Greenock had undertaken to supply at that price, but he should say that the company would be able to supply large consumers at less than 1d. per unit.

Lord Hamilton of Dalziel, one of the promoters, gave it as his opinion that the district proposed to be served would be better served by the Clyde Valley scheme than by the Caledonian.

Local evidence was then given by owners of works in the district as to the need that existed for a supply of cheap electrical energy for power purposes.

Mr. George Strain, C.E., of the firm of Messrs. Strain and Robertson, Glasgow, said that his firm were engineers for the scheme in conjunction with Sir W. Preece and Major Cardew. Besides being a member of the firm of Messrs. Strain & Robertson, he was chairman of two other large manufacturing concerns in Scotland, and he believed that it would be better for them to get a supply of electrical power from a company than to put in their own installation. The present scheme was, in his opinion, a thoroughly practical and workable one, and was needed in the district very much.

Evidence was then given on behalf of several burghs who are petitioning against the Bill.

Mr. John Cameron, of Greenock, said that the Greenock Corporation claimed that they were the first in Scotland to apply for a provisional order to supply electricity. They, however, allowed their first order to drop, because they could not get manufacturers to take the power. In 1898 they obtained further powers, and had spent £60,000 on their works, and had obtained loans of £100,000 from the Public Loans Commissioners. The policy of the Corporation had always been to keep ahead of the demand, and with that object they had increased their plant from time to time.

Mr. Parkinson, the newly appointed engineer and manager of the Paisley Corporation electricity works, gave evidence as to what his Corporation had done in the matter of providing a supply of electricity both for power and lighting purposes. In cross-examination, witness admitted that there was a loss last year of £4,000, which included interest and sinking fund.

Other evidence having been tendered on behalf of other Corporations in opposition to the scheme, the Committee adjourned.

Worcester Tramways.

The Worcester Tramways Bill should have come before the Select Committee of the House of Lords, presided over by Lord Ribblesdale on Monday, but it was announced that all opposition had been withdrawn, and it was accordingly referred to the Committee on Unopposed Bills.

Shannon Power Bill.

The Hon. Arthur Elliot's Committee of the House of Commons on Monday sat to consider and adjust the clauses of the Shannon Power Bill. The chief cause in dispute was with respect to the property of Major O'Connor at Reilly's Island. It was agreed that the promoters should purchase Major O'Connor's interest in the land before they commenced to abstract water from Lough Allen, and give him the option of repurchase two years after the works had commenced.

Other clauses were adjusted, and the Bill ordered to be reported to the House.

Birmingham Tramways Bill.

On Monday a Select Committee of the House of Lords, presided over by Lord Ribblesdale, considered the City of Birmingham Tramways Bill. The Hon. J. D. Fitzgerald, K.C., and Mr. Macassey represented the promoters of the Bill, the Birmingham Tramway Company, and the objectors were the Handsworth Urban Council and the Aston Manor Urban Council.

Mr. Fitzgerald, in opening the proceedings, stated that the object of the Bill was to enable the company to make some short extensions of their tramway lines, and other purposes. It was a most peculiar system, for the tramways were worked in four different ways, viz., horse, steam, cable, and one on the accumulator system, which it was sought under the Bill to convert into an electrical tramway worked on the overhead trolley system. The tramways in the City of Birmingham were owned by the Corporation and leased to the company, and that lease expired in 1907. Outside the city the lines were owned by the company, but they were, of course, subject to the provisions of the Tramways Act as to purchase by the local authorities, and the result was that the various lines became purchaseable at varying dates. What the company wanted now was a clause in the Bill to the effect that until the lease with the Corporation expired the other local authorities who might purchase should grant running powers to the company—that would be till January 1st, 1907. As to the working of the tramways, the Bristol Road route, which, up to the present time, had been worked by electricity on the accumulator system, and which was 3½ miles in length, would in future be worked in the ordinary way by the trolley system. They had arranged terms already with the Corporation and one outside authority with regard to this. What the company asked was that the question of whether the other local authorities were unreasonable in not consenting to the terms arranged with the City Corporation with respect to the improved means of traction should be referred to the Board of Trade or some other arbitrator appointed by them.

Evidence having been called,

Mr. Pollock, for the Handsworth Urban Council, said the Urban Council intended to purchase in 1903, and objected to any extension of the time of purchase or to any difficulty being thrown in the way of the local authorities. He should object to the vested right of the Council to purchase being interfered with.

Mr. B. Wilkinson, for the Aston Manor Urban Council, said that Council had obtained an Act last session enabling them to work their lines by electricity.

After some consultation it was agreed that Handsworth and Aston Manor should be excluded from the clause as to the renewal of their consent to the working of the Bristol Road line electrically.

The preamble of the Bill was then declared proved.

Dublin Tramways.

On Thursday last week the Dublin (St. James Gate Brewery), Tramways Bill came before the Chairman of Ways and Means of the House of Commons as an unopposed measure. The Bill authorises Messrs. Guinness, Son & Co. to construct and work tramways in the City of Dublin.

Tyneside Tramways Bill.

On Thursday and Friday a Select Committee of the House of Lords, under the chairmanship of Lord Ribblesdale, had under consideration the Tyneside Tramways Bill, which provided for the extension of tramways and tramroads from Gosforth and Walker, through Wallsend and Willington, to Tynemouth.

Mr. Balfour Browne, K.C., in opening the case, said the district in which it was proposed to extend the tramways between Newcastle and Tyneside was a most important one. They would run through the districts of six local authorities, of whom five were favourable to the Bill. The only authority whose area would be touched was the Walker Urban District Council, who were opposing the Bill. The other opponents were the Newcastle-on-Tyne Corporation and the North-Eastern Railway Company. Taking first the opposition of the Walker Urban District Council, he submitted that they had no right to be there in opposition at all, inasmuch as the views of the ratepayers had never been ascertained on the question of approving or disapproving the proposed tramways. The opposition of the Newcastle-on-Tyne Corporation was that they did not wish the Bill to pass because they themselves wished to exploit tramways in the district. The opposition of the North-Eastern Railway Company was simply on the ground of competition, but he submitted that the Committee would not be impressed with the agreements to uphold the railway monopoly.

Mr. J. H. Armstrong, one of the promoters, gave evidence in support of the scheme, and said that what was known as the No. 3 tramway had been thrown out at the instance of the Walker Urban District Council, although he was of opinion that it ought to have remained in, and they would be prepared next session to come to Parliament for powers to make it.

Further evidence for the promoters was called, as to the great public advantage the tramway would be to the district affected.

Mr. Morton Smith, who represented the Walker Urban District Council, said that that body considered the tramway scheme of the Newcastle district a better one than that of the promoters, but at the same time they did not wish to see the scheme before the Committee wrecked. He suggested that there should be a suspensory clause inserted in the Bill to the effect that if the Newcastle Corporation did not carry out what they had undertaken, viz., to construct a double line of tramways between Newcastle and Walker, then the company should have power to do so. Walker wanted a ripe and proper scheme, and a system of tramways which would run through the populous parts to Newcastle. They also objected to the purchase clause of the Bill.

Alderman W. Sutton was called on behalf of the Corporation of Newcastle who he said were the freeholders of Walker. They were anxious to see a proper scheme of tramways adopted, and were prepared to come next session to Parliament with such a scheme.

The Committee passed the preamble of the Bill subject to the promoters coming next year to Parliament for power to do whatever the Newcastle Corporation had agreed to do in Walker.

Underground Electric Railways.

On Thursday last week the Joint Committee of the Houses of Lords and Commons held their first sitting, under the chairmanship of Lord Windsor. The other members present were Lord Knutsford, Lord Lauderdale, Lord Herries, Sir J. Dickson-Poynder, Sir W. Arrol, Mr. Ashton, Mr. Cawley, and Sir M. Forster. The terms of reference to the Committee are as follows:—(1) Whether the lines of route for underground railways in and near London proposed by Bills which have been or may be introduced during the present session are best calculated to afford facilities for present and probable future traffic; and if not, what modifications of these lines of route are desirable. (2) What special provision, if any, should be made for the protection of owners, lessees, and occupiers of properties adjacent to underground railways from possible damage and annoyance. (3) What special terms and conditions, if any, as to construction and working should be imposed upon the promoters. (4) Whether any, and which, of the schemes proposed by the said Bills should not be proceeded with during the present session. All the underground electric railway Bills are referred to the Committee.

After the Committee had conferred privately for some time, counsel were admitted, and

The CHAIRMAN said the Committee had decided that they would meet at 11.30 on Tuesdays and Fridays to begin with, but if necessary they might meet oftener afterwards. They proposed to apply for the leave of the House to hear counsel. At present it was not proposed to enter on the vibration question, but to wait until Lord Rayleigh's Committee had reported. In the first place, therefore, evidence would be confined to the first point of reference, as the other points would, in the opinion of the Committee, depend to a great extent upon the report of Lord Rayleigh's Committee, and, therefore, they did not intend to waste time in going into the question of vibration and other matters at that stage. With regard to the manner in which the promoters of the Bills desired to bring them before the Committee, he asked for the views of the representatives in the room.

Mr. HUTCHINSON said he appeared for the promoters of the Charing Cross and Hampstead Railway, but the matter of procedure had not yet engaged the attention of the promoters.

Lord ROBERT CECIL, K.C., said he represented a large number of landowners who were interested in several of the Bills, and it would be a great convenience to them if they could be informed when they could be heard, and he would like to know to what extent they would be heard. Otherwise it would be necessary for the promoters to make their case with great elaboration, and it might turn out that a great deal of the expenditure would be thrown away.

The CHAIRMAN asked if the landowners' interests were directed especially to the first point of the reference. As he had said they did not propose to discuss questions of compensation or damage at present, as they thought that depended on the report of the Vibration Committee.

Lord ROBERT CECIL said that no doubt that vibration would be the most important question for landowners, but their interests might be considerably affected by the actual route which the railway took.

Mr. HUTCHINSON said that it might be that some of the schemes would not be accepted at all, and consequently the difficulties of the landowners might be swept away. If the Committee were of opinion that some of the schemes would afford facilities for the public they would go. He appeared both for and against some of the Bills, and he suggested the advisability of strictly confining the proceedings at first to the selection of what railways should ultimately be sanctioned upon the ground of public facilities quite as apart from any other question.

Lord KNUTSFORD remarked that that was exactly what they wished to do. With regard to what Lord Robert Cecil had said, he could not see that there would be much evidence wanted on the part of landowners as to what should be the best line of route for the relief of traffic.

Mr. HUTCHINSON said he could not conceive that there could be any evidence.

Sir BRYCE GOLDREY suggested that all the lines which passed through the City might first be proceeded with.

Mr. LITTLER said he was in the position of appearing for the promoters of some of the Bills, while he opposed others on behalf of railway companies. He suggested that it would be better for the Parliamentary agents for the different Bills to meet together and formulate some form of procedure for the Bills. If the agents could not agree, they could take the Bills in alphabetical order.

Lord KNUTSFORD: Yes.

Mr. BAGGALLAY said he appeared on behalf of the eight water companies and the three gas companies of London, and he took it that the proper time for him to appear would be on the ground of construction and working.

Lord KNUTSFORD: Yes.

Mr. WALLACE, K.C., said he appeared for the electric lighting companies, and the same observation would apply.

Mr. LITTLER said that, of course, competing schemes would be taken with each other.

The CHAIRMAN said the Committee would leave it to the agents to say which Bill should be the first to be brought forward.

After further discussion it was pointed out that there would be little likelihood of the agents agreeing, and it would be better if the Committee decided first to take the Brompton and Piccadilly Bill.

The CHAIRMAN said the Committee were prepared to do this.

Mr. HUTCHINSON said the Charing Cross and Hammersmith Bill competed with the Brompton and Piccadilly.

The CHAIRMAN said the Committee would take the Brompton and Piccadilly Bill and any competing scheme first, and would leave it to the agents to state at the first sitting what procedure they cared to adopt.

The Committee sat on Tuesday, when the case of the Brompton and Piccadilly railway was gone into.

At the outset of the proceedings, Mr. LITTLER, K.C., asked that the Bills for the Charing Cross and Euston and the Hampstead railway might be put in the list for Friday, when he proposed to ask his Lordship to let those Bills be taken out of the Joint Committee altogether, and referred to a Committee in the ordinary way. It was very important that that should be done, because contracts had been entered into with regard to the construction of the main lines, and he did not believe that any question would arise as to the route or in respect to vibration.

Replying to the CHAIRMAN, Mr. LITTLER said that the schemes to which he referred were before a Committee in 1892, and then Mr. Beachcroft, as representing the L.C.C., urged that a condition should be put upon the promoters that they should make the very extensions they now desired to do, but Parliament declined to make them compulsory. He believed there was no objection on the score of competition.

The CHAIRMAN said the opinion of the Committee was that they could not take the Bills out of their consideration without a further reference to the House, and he would communicate with the Chairman of Committees on the subject.

Mr. BOYLE, as representing the City and Brixton line, which he said was simply a matter of a small extension of time, also applied for that Bill to be left out of the list.

Mr. FITZGERALD said he appeared on behalf the L.C.C., to say that, recognising as they did the vast importance of the questions involved in that inquiry to the people of London, they were desirous of giving to the Committee every information and assistance in their power, and if there was any question on which the Committee would like information which was possessed by the Council, it was entirely at their disposal. They would suggest that the questions involved should be treated as a whole, and that the Committee should not give their decision on any one line until they had heard the evidence for the whole of the Bills. The Council felt that at the present time it would be premature on their part to offer evidence, but at the proper time they would be prepared to give evidence on the general questions involved, and also as to their application to the particular schemes before the Committee.

Mr. LITTLER said he should object to the L.C.C. giving what they termed general evidence. All they should be allowed to do was to cross-examine witnesses who were called in support of any particular scheme.

Lord KNUTSFORD remarked that the Committee had to decide whether the routes proposed afforded the best facilities for traffic in the various districts, and it would be better for Mr. Littler to let his Bills come on in their proper turn.

The CHAIRMAN, after consulting with his colleagues, said the decision of the Committee would be given upon the whole of the Bills together, but he thought it would be for the general convenience that in considering the facilities and the route of a particular Bill, the L.C.C. should state their objections, if any, at the time the particular Bill was before them.

Mr. FITZGERALD said that he would take care that that view should be brought before the Council.

The Brompton and Piccadilly Railway.

Mr. LITTLER then opened the case for the Brompton and Piccadilly Bill. He said all they were asking for was a very small extension of an authorised line which was discussed very carefully as long ago as 1897. The authorised line started with the junction of the District Railway at Earl's Court, it then passed along by the Gloucester Road Station and on to South Kensington, and there it dipped down to a great depth underground in order to meet the scheme of the deep level line of the Metropolitan District Railway, which line would in all probability be worked by electricity. The end of the authorised line was at Piccadilly Circus, and thus it would provide that district with an electric underground railway. A couple of years ago they entered into a contract for the construction of the works, and also for the electrical equipment of the line, the latter contract being given to the Brush Electrical Engineering Company. The extension they now asked power for was to extend the line from Piccadilly to Bloomsbury, where there would be a junction with the Central London Railway. If the Central London extended their line, as he believed they proposed, from the Mansion House to Liverpool Street, there would be a route right through the West End of London to the East and North-east, which would be of immense advantage to the public. The extension was essentially a part of their original scheme, and he believed the Committee would see the wisdom of granting what the company desired.

Sir JAMES SZLUMPER, C.E., gave evidence bearing out the opening statement of counsel, and explained how advantageous the extension would be from a public point of view in giving communication from the West to the East of London.

Cleveland and Durham Electric Power Bill.

On the Committee resuming the consideration of this Bill on Wednesday, last week, the Chairman intimated that the Committee thought a more rapid progress might be made by the promoters.

The evidence of Mr. HARRIS was continued, and he stated in re-examination that by the Bill the Durham Company would be able to supply customers in what was known as the neutral district.

Mr. A. H. SILL, the clerk to the Ormesby and Redcar Urban District Councils, was called in support of the Bill. He stated that the Ormesby Council had obtained a provisional order about a year ago, but had taken no steps to carry it into effect. They found it would cost £8,000 to put down their own plant, and considered that the promoters would be able to give them a cheaper supply under the Bill. The Redcar Council obtained a provisional order about the same time, and it was estimated that it would cost them about £10,000 to put down their own plant. They had negotiated with local private companies for a supply of current, but it was found that they could not supply them as cheaply as the promoters of the Bill would be able to. In the case of both Councils they had decided not to put down their plant until they saw what the fate of the Bill would be. If the Bill passed, he believed that both of the Councils he represented would be customers.

In cross-examination, WITNESS said they had applied to the Middlesbrough Corporations for a supply, and were informed that the Corporation had no power to supply outside its own area.

This concluded the case for the promoters.

Mr. Baggallay then addressed the Committee for the Stockton and Middlesbrough Corporation, who were opposing the Bill, and said he should ask that a similar provision should be inserted in the Bill to that which was made in the South Wales Bill of last session. In effect the provision was that the company promoting the Bill should not exercise any of the powers conferred upon them within Stockton and Middlesbrough for any other purpose than the laying of mains through those districts to other districts, except with the consent of the Councils of the two boroughs. He realised that it was too late in the day to argue that electric power was not desirable, for there was no doubt but that the commercial interests of the country required that it should be brought into large industrial centres. There were no doubt districts in the neighbourhood where the company might do a great deal of business in the way of supplying the power, and the Corporations he represented wished to place no obstacles in the way by refusing to consent to the laying of mains. All they wanted was fair and due protection for the Corporations of Stockton and Middlesbrough.

The Chairman pointed out that as these two Corporations were authorised distributors they would be protected by the Bill.

Mr. Baggallay argued that they would not be adequately protected, because in the Bill it stated that consent should not be unreasonably withheld. The case for the scheme was that economical production of power could be brought about, and he quite admitted that was a good ground to go upon. What he did say, however, was that the two boroughs he represented had equal facilities for giving that economical electric power. There was horse-power available going in Middlesbrough which was sufficient to more than satisfy all requirements, and it was hard upon the two towns that having recently started their works they should be deprived of their best customers by the company stepping in.

Mr. R. Hammond, consulting engineer to the two boroughs, was called, and stated that he looked upon the two towns as ideal places for the generation and distribution of electrical energy, and they possessed all the conditions necessary to economical production. If the Bill was carried the two boroughs would still have to carry on their undertakings. He was confident that Middlesbrough could cope with all demands made upon it for either light or power.

Mr. Hynd, ex-Mayor of Stockton, stated that the Corporation had spent £29,000 on the electrical works, and were prepared to spend more to meet all demands.

On Friday last week Alderman T. M. Barrow, Chairman of the Gas and Electric Lighting Committee of the Darlington Corporation, stated that the horse-power of Darlington was about 7,500 [?] and the Corporation could well supply all the electric power that was required. There was no place beyond Darlington which the company could wish to supply from any of their generating stations, at any rate, there was none that they could supply profitably. If there were any places that they might attempt to supply they could do so without laying their mains through Darlington. The Corporation had recently been negotiating for the purchase of the tramway system and the price to be paid had been settled. Indeed the Corporation had been quite awake to the interests of the place. They obtained their provisional order for electric lighting in 1890, at which time their area was confined to Darlington proper.

In cross-examination, Witness said he felt the Corporation would raise no difficulty as to the company taking mains through their area, but there was nothing beyond them that would require electrical power, for beyond them there was a large agricultural district. He could not say that at present they had sufficient plant to supply all the needs of Darlington. At present they had a rapidly increasing demand for lighting.

Questioned by a member of the Committee, the Witness said that one objection to the company laying their mains through their streets was the breaking-up of the thoroughfares. It was also thought that if they went through the town, they would compete with the Corporation.

Mr. Fitzgerald addressed the Committee on behalf of the Hartlepool and Darlington Corporations, and said what they desired was the insertion in the Bill of a clause that the powers of the Act were not to be exercised by the company within their areas without the consent of the Corporation.

Mr. Balfour Browne then replied on the evidence, and on the arguments put forward by counsel for opposing boroughs. He said there was really no opposition to the preamble of the Bill, all the local authorities being at one with the promoters in thinking that that or some similar company could supply electrical power with advantage to the district; they only objected to powers being given to the company to come and supply within their areas.

The Chairman said the Committee had agreed to take time to consider their decision, and it would therefore not be given until Monday, when possibly clauses might have to be discussed.

The Select Committee of the House of Commons resumed its consideration of the Bill on Thursday last week. At the outset the Chairman intimated that the Committee had pretty well made up their minds on the Bill.

Evidence was then called on behalf of the Stockton Bridge Board of Commissioners on the question of the powers of the promoters to use the bridge in question. The Board opposed the granting of any compulsory power to the promoters to deal with the bridge.

Mr. Johnson, the engineer to the Stockton Bridge Board, admitted that there would be no practical difficulty in carrying wires across the bridge, although it could not be done in a way which would be approved by the Board.

Questioned by the Chairman, he admitted that they could carry 10 mains across the bridge by altering the structure.

The Chairman said he thought the promoters of the company might come to some arrangement which would take the form of a clause.

Mr. Forbes Lancaster (for the Stockton Board) said his clients had no wish to be unreasonable, and they would doubtless agree upon a clause.

Mr. D. Williams then addressed the Committee on behalf of the West Hartlepool Corporation in opposition to the Bill, and contended that it was clear by the evidence that under present conditions the company would not have the slightest chance of securing customers above a certain degree of H.P. The big concerns already had their electric installations, and the Corporation had now a station which would admit of all the extensions likely to be required for some years to come. All the Corporation wanted was to be excluded from the area in the Bill, and for it to be laid down clearly that no mains were to be laid within the town except with the consent of the Corporation.

Mr. A. C. Crummack, borough engineer, stated that Hartlepool obtained a provisional order 18 months ago. Work on the generating station had not been commenced, but the scheme was being prepared, and they were going to provide for about 300 H.P. at first. The buildings would, however, be designed to admit of extensions.

In cross-examination, Witness said he had been instructed to prepare to supply power as well as light. They were going to spend £15,000 on their works.

Mr. Macaskie, on behalf of the Thornaby Town Council, said the town had only been incorporated since 1892, and they had had no time yet to get a provisional order. All they asked was that the company should not be allowed to lay mains or supply current within the borough without the consent of the Corporation.

Prof. Kennedy was called by Mr. Fitzgerald, K.C., on behalf of the Darlington Corporation. He said he had been employed by that Corporation to design their electric light and power stations, and their system generally for distribution. In the first instance they put up a plant which was now working at about 400 H.P., and he was now in correspondence with the Committee as to the extensions which would bring the power up to between 800 and 900 H.P. Arrangements had also been made for the purchase of the tramways by the Corporation, and that would speedily double the horse-power again.

The Select Committee considering the Bill met again on Monday, and sat in private for several hours to formulate their decision.

On the resumption of the public proceedings, the Chairman said:—The Committee have decided that the preamble of the Bill is proved. Of course they have given very careful consideration to the position of the authorised distributors in the area, and have come to the conclusion that they are sufficiently protected under the Bill, except in one point, and that is with reference to the price which the company may charge the authorised distributor in the area when he takes in bulk under clause 43 of the Bill. The Committee think that it will be necessary to insert in that clause either a substitution for the words, "at a price not exceeding," the prices stated in the second schedule, or, leaving that, as a proviso, what is known as the most favoured nation clause which will be found in the South Wales Act, in Sec. 51, Sub-sec. 3. With that addition to Clause 43 of the Bill, the Committee think that ample reasonable protection is given to the local authorities.

Mr. Balfour Browne, on behalf of the promoters, said they would be perfectly prepared to bring in such a clause.

The Chairman: I think there are only two other points I need refer to. One has been already referred to, and that is with regard to Stockton Bridge. I think it was understood that the Committee thought there ought to be consent on the part of the authorities of the bridge, and possibly some provisions. I think it was left to counsel to see if they could arrange a satisfactory clause with reference to Stockton Bridge. There is just one other point, and it is that in the sliding scale, Clause 51 of the Bill, the Committee wish to substitute 4s. for 5s., leaving the 8 per cent. dividend as it was in the South Wales Bill in order to make it more logical and consistent with the original idea.

The Committee then adjourned.

On Tuesday the Committee considered the clauses of the Bill.

A proviso was brought up to add the following to Clause 43, which authorises the company to furnish a supply of energy to authorised distributors:—"Provided always that the company shall grant to any such distributor as favourable terms and conditions for a supply of electricity as those granted by the company to any other authority, company, or person whose circumstances are similar."

Mr. Russell, K.C., said that by Sec. 20 of the Electric Lighting Act, 1882, the object the Committee had in view was already attained, and he hardly thought the proviso was necessary.

The Chairman said the Committee would like to have the proviso, because it made the position quite clear and carried out the idea they had in their minds.

The proviso was then agreed to, with the addition of a further proviso:—"That nothing in this section shall prejudice the provisions of Sec. 20 of the Electric Lighting Act, 1882."

The remaining clauses were then gone through, and the Speaker reported the Bill as amended to the House for third reading.

ELECTRICAL ENGINEERS R.E. (VOLUNTEERS).

REGIMENTAL ORDERS.

1. A roll of N.C.Os. for duty is posted at headquarters.

2. *March Out.*—A march out will take place on Saturday, May 11th. Parade headquarters 3.30 p.m. Dress: tunic, parade trousers, forage cap, leggings, rifle, bayonet, pouch in centre of back.

3. *Recruit Drills.*—Tuesday and Thursday, 6.30 p.m. and 7.30 p.m.

4. *Instruction in Engine Driving.*—N.C.Os. and men for trainings, June 8th to 15th, and June 15th to 22nd will parade for instruction in oil engines at headquarters on Tuesdays and Thursdays at 6.30 p.m.

N.C.Os. and men for trainings July 6th to 13th, and 13th to 20th, on Mondays at 6.30 p.m.

N.C.Os. and men for trainings July 20th to 27th and August 8th to 17th, on Wednesdays at 6.30 p.m.

N.C.Os. and men for training August 17th to 24th, on Fridays at 6.30 p.m.

5. *Bugle Band.*—A bugle band is being formed; there are a few vacancies for lads from 15 to 17 years of age.

6. *Commission in Army.*—The undermentioned officer is granted the temporary rank of lieutenant in the army whilst serving with a volunteer section in South Africa: Second Lieut. T. Rich, the Electrical Engineers R.E. Volunteers, dated February 23rd, 1901.

7. *Enrolments.*—The undermentioned, having been enrolled, are taken on the strength of the corps:—Reg. No. 530 T. A. Barnes; 531 A. G. Chisnall; 532 T. H. Dennis; 533 F. E. Peel; 534 C. H. Redgwell; 535 P. M. Robinson; 536 H. B. Shepheard; 537 G. W. C. Clack; 538 E. C. Price; 539 R. Porter.

(Signed) R. S. ERSKINE, Major,
O.C.E.E.R.E.V.

CORRESPONDENCE.

Synchronising of Alternators.

I am afraid I cannot agree with Mr. Hopps's remarks on the "Synchronising of Alternators" in your issue of April 26th.

The arrangement he proposes fails to indicate clearly when the machines are absolutely in phase, since his phase needle has a scale all to itself. It is first of all necessary to find on that scale the point corresponding to the voltage of the two alternators, and see that the phase needle turns back at that point. In this it is easy to make a mistake, especially when in a hurry.

In the arrangement I described, it is only necessary to see that the phase needle and bus bar needle coincide regardless of their position relative to the scale.

The very objection raised by Mr. Hopps at the beginning of his letter is, I think, a point in favour of the two-needle voltmeter. It is not desirable to switch the incoming machine in unless its voltage is the same as that of the bus bars, nor is it desirable to switch it in unless the beat of the phase needle is slow. If the phase needle will show a difference in voltage, it is all that is required since an adjustment should then be made in whichever way the difference had been discovered.

There is, however, one drawback to the method I have described; it is possible even when the voltage of the bus bars and that of the incoming machine is the same, for the phase needle to fall short of the bus bar needle. This simply means that the machines are not yet in phase, but might lead to a premature adjustment of voltages. (It will be noted that under such circumstances it is not possible for the phase needle to swing beyond the bus bar needle.)

Very little practice and the observation of a few successive swings carry one over this difficulty.

A positive remedy is to connect Mr. Hopps's voltmeter, so as to leave the single needle to show the voltage of the incoming alternator, and retain the double needle scale for the bus bar voltage and phase indicator.

The voltage of the incoming machine could even more conveniently be shown on an independent voltmeter, to be referred to in case of the above-named difficulty arising.

Such an independent voltmeter with its scale in the same position as the synchronising voltmeter, would not only be cheaper, but also easier to read.

V. A. F.

Bradford, *May 1st*, 1901.

Electric Blowing at Lincoln Cathedral.

Messrs. Bergtheil & Young state in your last issue, in reference to the above, that "the contract and all responsibility in connection therewith was placed with Messrs. Bergtheil & Young, and has remained with them ever since."

That the contract was placed with them is true, but since January last the arrangement of the plant has undergone many alterations and modifications, and there is little of it remaining now as originally installed by them, so that in any account of the existing arrangements it would not be correct to describe it as being their work.

As regards present responsibility, we quote from a letter written by them on January 26th of this year, which says: "We note that the Dean and Chapter have decided to place the order for the alterations as per our estimate with a local firm. If this is done, you will of course clearly see that we can take *no responsibility whatever* in the matter of working the plant."

The alterations alluded to were made by two local firms, viz., Messrs. Foster & Co. and Messrs. Rainforth & Sons.

F. H. Hutton.
H. Mantle.

May 4th, 1901.

Where to Construct New Electrical Works.

May I venture in answer to your correspondent's queries under the above heading in your issue of May 3rd, to advance the claims of Reading as an advantageous locality for the establishment of new manufacturing works?

Its *railway facilities* are probably unequalled in any other town within 50 miles of the metropolis.

Labour is cheap.

Power is supplied by the local electric supply company at 1½d. per B. of T. unit.

Land with low ground rents is plentiful, there being several hundred acres obtainable at the present time at about £60 to £70 per annum per acre on 99 years' lease.

That these qualities are fully recognised is evidenced by the fact that within the last 12 months one large London engineering firm, and two well-known London printing establishments have commenced building new works here.

Arthur S. Cooper.

Reading, *May 4th*, 1901.

In answer to Mr. Richard V. Lynn's letter in last week's ELECTRICAL REVIEW, I beg to call his attention to Rugby, in Warwickshire, which bids fair to become an important centre of electrical activity. Messrs. Willans & Robinson's large and important high-speed engine works have now been established here some years, the British Thomson-Houston Company are building very extensive works for the manufacture of all kinds of electrical machinery, and the British Electric Traction Company have acquired some 8 acres of ground, and are starting building shortly.

Rugby has many advantages, and now this has once been recognised, I feel sure great developments are in store for the town. The chief advantage Rugby possesses is undoubtedly its central position, coupled with its great railway facilities. It is, as most people are aware, one of the most important junctions on the London and North-Western Railway, and the company have large repairing and erecting shops here.

It is only 82½ miles from Euston, the frequent expresses do the journey in less than 1¾ hours, and the traffic through the station is enormous. The Midland Railway run into the station from Leicester, and the Great Central Railway have also a station here on their new main line to London (Marylebone).

Rugby is a very healthy place, and has important educational facilities.

Alfred Fell.

Mill Lighting.—The electric lighting of Wooburn Mills is now being carried out. Mr. H. Taylor (Messrs. Taylor & Field) is the consulting engineer.

BUSINESS NOTES.

Electrical Wares Exported.

Week Ending May 8th, 1900.		Week ending May 7th, 1901.	
Amsterdam	Value £280	Alexandria	Value £63
Bombay	180	Amsterdam	127
Calcutta	760	Bombay	163
,, Te'eg. mat. ..	317	Br.sbane. Teleg. mat.	98
Cape Town	554	Buenos Ayres. Teleg. mat. ..	150
Colombo. Teleg. mat.	16	Bushire. Teleg. mat.	50
Durban	567	Calcutta	1,543
,, Teleg. plant	5,946	Cape Town	310
Gibraltar	20	Coatzacoalcos	1,522
Gothenburg	25	Colombo	284
Hamburg	27	Durban	558
Hong Kong	84	East London	38
Kobe. Teleph. mat.	659	,, Teleg mat. ..	64
Madras	909	Gibraltar. Teleg. mat.	121
Nagasaki	127	Hamburg. Teleg. mat... ..	500
New York	355	Hobart	10
Ostend	8	,, Teleg. cable	279
Port Darwin. Teleg. mat. ..	80	La Plata. Teleg mat.	29
Rouen	105	Monte Video. Teleg. mat. ..	21
Shanghai	121	Nagasaki	1,695
Singapore	90	Ostend	50
Wellington	51	Perth	480
		Rangoon	87
		Rio Janiero. Teleg. mat. ..	943
		Rosario. Teleg. mat.	77
		Rotterdam	38
		Santos	26
		Shanghai	100
		Stockholm. Teleg. wire ..	139
		Sydney	597
		,, Elec. glass globes ..	1,110
		Tokio	28
		Townsville	1,056
		Valparaiso	149
		Wellington	17
		Zanzibar	82
Total ..	£11,181	Total ..	£12,544

Foreign Goods Transhipped.

Fremantle. Elec. goods..	Value £195

Alloa.—Rapid progress is being made with the erection of the extensive works at Alloa of the British Electric Plant Company, Limited, the firm which secured the contract for the electric installation of the burgh of Alloa, in Clackshire. The works, together with the adjacent yards, cover an area of over five acres. The manager has intimated to the Town Council that the company expects to be able to supply electricity by the month of October or November at latest. The Corporation are accordingly making arrangements for the wiring of the Town Hall (along with the Reading Room and Public Library) and the Municipal Buildings. Mr. Hogarth (of Messrs. Buchan & Hogarth, electrical engineers, Edinburgh), acting for the Town Council, has fixed the sites of the 18 arc lamps for the principal streets of the town. The cost per unit has not yet been decided, but it is expected to be either 5d. or 6d. The price of gas per 1,000 cubic feet in Alloa is 2s. 6d., the second cheapest in Scotland.

Bankruptcy Proceedings.—A receiving order having been made on a creditor's petition against A. W. B. Pearson, electrical contractor, 81 and 82, Palmerston Buildings, E.C., the first meeting of creditors was held on Monday last at the London Bankruptcy Court before Mr. C. A. Pope, assistant receiver. Prior to 1898, the debtor travelled on commission for firms in the electrical line, but in that year he commenced business on his own account as Pearson and Co. He started with a free capital of his own of £2,500, and subsequently put in other sums derived from his commission accounts, also about £2,000 lent him by his wife. It was stated that during the first nine months he was also assisted by other persons who provided one-half of the capital and took one-half of the profits, but that the arrangement was terminated in consequence of the objections preferred by certain electrical contractors. Part of the debtor's business was to contract with the London County Council and other public bodies, and it appears that work resulted in a profit. The debtor has also been interested in various patents and secret processes. Among the number were Eborine, a vulcanite substitute, a rotary engine pump, a patent switch, artificial india-rubber, a method of treating waste cork, &c., for the manufacture of flooring and paving, and a dry cell. A private meeting of the creditors was held early in March, when an offer of a composition of 10s. in the £ payable by equal instalments at three and six months respectively was submitted, but it was not unanimously accepted, and the present proceedings followed. The debtor attributes his position to the failure of a number of persons to meet their acceptances which he had discounted at 1 per cent. above the Bank rate. The chairman reported that the debtor was unable to be present at the meeting, but he had furnished draft accounts showing liabilities £10,216 6s. 5d., expected to rank against assets valued at £13,814, and consisting chiefly of his interest in land and other property in Africa and Mexico. In the absence of any offer a resolution was passed for Mr. J. R. Woodly, accountant, 20, Cheapside, to act as trustee and administer the estate in bankruptcy assisted by a committee of inspection. The public examination is appointed for June 7th.

At the Birmingham County Court last week, Albert Isaac Greenberg, trading as the Midland Electrical Company, came up for examination. Liabilities, £839; assets, £104. The examination was concluded.

A receiving order has been made against Messrs. G. F. Cook and Co., electrical engineers, of Bradford. They attribute their failure in the last instance to the effect of a dispute with the Bradford Board of Guardians, with whom they had contracted for an electrical installation. When they found themselves in difficulties they offered 10s. in the £ to the creditors, but one refused to accept, and they had to file their petition.

Dissolutions and Liquidations.—The British Electric Works Company, Limited, is winding up voluntarily. A petition has been presented for compulsory liquidation.

A meeting of the Electric Organ Company is to be held at Norwich on June 5th, to hear an account of the winding-up proceedings from Mr. A. Foxworthy, the liquidator.

Messrs. A. G. R. Hawkes, J. J. DeLacy, and H. K. DeLacey (Hawkes & DeLacey, electrical and general engineers, Liverpool) have dissolved partnership.

Book Received.—"American Street Railway Investments for 1901." New York: Street Railway Publishing Company. 5$00

Catalogues and Lists.—The British Westinghouse Company's list, No. 1,045, is devoted to lightning protection for alternating and direct current circuits. No. 1,046 describes alternating current fan motors.

The B.T.H. Company's pamphlet, No. 94, deals fully with transformers of several types.

From Messrs. Drake & Gorham we have received a copy of their latest catalogue of electric lighting plant. By means of a convenient thumb index, reference to the different sections is facilitated. There are some notes on the questions of initial outlay and working costs of country house installations, a class of work in which the firm are specialists by reason of the great number of plants which they have put down throughout the country. One department deals with the steam and gas, oil, and water, part of the generating plant; others with dynamos and motors, and accumulators; cables and wires; switches, switchboards, &c.; sundry lighting and telephone fittings; the Jandus arc lamps, also farm machinery, circular saws, pumps, &c. Specimen estimates and a wiring table are also included in this very useful, well printed, and fully illustrated catalogue.

Messrs. A. Gallenkamp & Co., Limited, of Sun Street, Finsbury Square, E.C., have issued a new and comprehensive catalogue of chemical apparatus. The book has between 600 and 700 pages, and is strongly bound. A great variety of apparatus is detailed, each item having reference numbers, and most of them being illustrated. Balances, drying ovens, furnaces, laboratory stands, glass apparatus, hydrometers, thermometers, &c., are a few of the things particularised.

Messrs. E. F. Moy, Limited, are sending out priced sheets of their distributing fuseboards.

A new booklet has been issued by Messrs. J. Gibbs & Son, of Liverpool, in which they give particulars of their various standard makes of fans, also their patent motor safety starting and regulating switches.

Mr. C. Lohmann, of Aldersgate Street, E.C., has brought out a "new century catalogue" of cycle and motor accessories for wholesale and export buyers.

A catalogue of tramway tools, supplies, and sundries has just been produced by Messrs. R. W. Blackwell & Co., Limited. Enclosed spring trolleys, "Van Dorn" couplers, track brush-holders, sand boxes, electric heaters, car-replacing jacks, portable rail saws, track drills, bonding tools, guard strips, overhead line tools, circuit breakers, and many other things of this character are illustrated.

One of the most artistic lists that we have seen for a long time is the revised engine catalogue of Messrs. Mather & Platt, Limited. It is an enlargement on the last edition, but is of quite a handy and convenient size. The best work of the photographer and process-block maker, and of the printer, are made use of with excellent results. The engines are of the double-acting open vertical marine type. Tables are given of the engines as built for combined and independent plant purposes, showing output, weights, and dimensions. Enclosed high-speed engines are shown driving dynamos. Condensing and other auxiliary plants are described, also electrically-driven patent variable stroke pump, steam-driven feed pumps, and feed-water filters.

Company Notice.—In consequence of a petition to the Courts, the name of the Electric and General Corporation, Limited, has been restored to the Register.

Engine Packings.—A lavish variety of engine packings is offered to engineers by Cresswell's Asbestos Company, Limited, Bradford, ranging from the old-fashioned junk ring to the most modern metallic packing, with all sorts of asbestos and similar forms, dry or lubricated, cored or solid. To enumerate the various kinds would occupy too much space, but we may mention that Messrs. Cresswell give the chief place to a "square solid plait," permeated throughout with special lubricant; this is unaffected by extremes of cold or heat, by brine, alkali, &c., and is very durable. The company also supplies asbestos yarn and other engine stores.

Scotch Agency Notice.—Messrs. J. & A. Anderson, of 62, Robertson Street, Glasgow, have been appointed agents for Messrs. Walker & Hodgetts, Limited, dynamo and motor manufacturers, and for Messrs. Heaton, Smith & Co., Limited, electrical fittings manufacturers.

London County Council.—The Council at the meeting on Tuesday resolved to lend £5,160 to the Stepney Borough Council for the electric lighting of the streets.

The Highways Committee reported that the Board of Trade had approved the plans submitted by the Council, showing the rail and substructure proposed to be used in the reconstruction for electric traction of the tramways between Westminster Bridge and Tooting, Blackfriars Bridge and Kennington Park, and Waterloo Road and St. George's Circus. The Board had also approved provisionally the proposed system of traction, in so far as the use of a pressure not exceeding 500 volts was concerned, although this approval was subject to any requirements which might be considered necessary on the inspection of the completed works. Further details of a technical character were required by the Board of Trade in regard to the supply of energy to the proposed sub-station at Balham at a pressure of 6,500 volts, and the Committee had given instructions for the information to be prepared and submitted to the Board.

In a further report the Highways Committee referred to the recent inquiry held by the Board of Trade to consider the question of a change in the pressure of supply from 100 volts to 200 volts, and to the decision of the Board in regard to the question. The Committee expressed the opinion that the Council would consider the Board's decision, which was given in this journal last week, to be satisfactory, inasmuch as by it the principle for which the Council contended was upheld, and under the new regulations reasonable protection was afforded to the consumer.

It was stated by the Building Act Committee that plans had been submitted with an application by Messrs Gordon & Gunton on behalf of the Hackney Borough Council for the erection of a generating station and works in Millfields Road. The construction of the walls of the building was deemed unsatisfactory, and the Committee recommended the Council to disapprove the plans. The recommendation was, however, withdrawn.

Rosin Cored Solder.—We have received samples from the Patent Solder Company, Limited, of their rosin cored solder, which consists of a tube of solder filled with rosin, and is manufactured in four useful sizes. The advantages of having the flux combined with the solder, in point of cleanliness and convenience, are obvious.

Strike in the Iron Tube Trade.—The *Liverpool Mercury* says that on 7th inst. the employers in the Staffordshire wrought-iron tube trade resolved to continue the lock-out against the men in the socket and fitting makers' branches. It was reported that the masters as a body continued as united as ever, and that there was no chance of the acceptance of the men's offer that they should be allowed to resume work, the terms of settlement to be decided afterwards. The employers declared that such a course would be to give the position away, and that the 10 per cent. reduction must be enforced.

Thermit Welding.—A demonstration was given in Westminster last week of Dr. Hans Goldschmidt's thermit welding and fusing process, preparatory to the forming of a company for working the patents in the United Kingdom. As a formidable rival to electric welding, the subject is of interest to many of our readers. The arrangement for the welding of tubes consists of a small sheet-iron casing jacketed with moist sand kept in place by an outer box, within which the clean cut and squared ends of the pipes are clamped into position and finally screwed into contact. The thermit is prepared in a crucible, and immediately poured into the mould. As soon as the welding temperature has been reached, it is necessary to tighten up the screws by one turn, in order to obtain the requisite pressure for welding. A 3 in. pipe, 0·16 in. thickness, can be welded with 5 lbs. of the thermit. The distance of the sheet-iron mould from the outside of the pipe is 0·72 in., and the length of the mould is 3·20 in. A welding temperature is reached 1½ minutes after the melt is poured in. This method of welding tubes may be employed in all positions of the tube, and whilst the tube is being laid, and can therefore replace flanged joints. The application of the process to rails in position in the track, which was also illustrated, is said to have been successfully carried out on electric tramways in some Continental cities. As compared with electrical welding it has the advantage of needing no cumbersome machinery, and the inventor claims that it is not only much less costly, but also reliable in results.

The theory of the process, and the methods of employing it for various purposes, were described in our issue of November 2nd, 1900.

Trade Announcements.—We are informed that Messrs. P. C. Middleton & Sons, electrical engineers and contractors, have commenced business at 63, Union Street, Aberdeen, and would be glad to receive trade catalogues and price lists.

Messrs. George Fletcher & Co., engineers, &c., are now represented in London by Mr. H. Bath Spencer, M.I.Mech.E., at 21, Mincing Lane, E.C., and he will devote his attention particularly to condensing plant installations for power stations.

Messrs. Browett, Lindley & Co., of Patricroft, Manchester, have appointed Mr. John A. Rudd, 177, West George Street, Glasgow, to be the sole representative for Scotland for the sale of engines, &c, manufactured by them.

The China and Japan Telephone Company has a petition before the Courts to confirm a resolution of the company altering its name to the China and Japan Telephone and Electric Company, so that it may also engage in the business of an electric light and power company, &c. The notice appears in our business pages this week.

ELECTRIC LIGHT AND POWER NOTES.

Alfreton.—The B. of T. has refused to grant a prov. order for electric lighting to the U.D.C., which, by the way, has decided to oppose the Derbyshire and Notts Power Bill, and has incurred considerable expenditure already.

Beckenham.—The members of the District Councils' Association have arranged to visit the Beckenham electric lighting station on the occasion of the annual meeting, which will be held in London on July 5th.

Bradford.—The Bradford Board of Guardians will shortly invite tenders for the completion of the installation which was being carried out on their premises by Messrs. G. F. Cook & Co., of Bradford, but was peremptorily stopped by the Guardians on the ground that the contract conditions were not being fully complied with.

Burnley.—The T.C. has resolved that a resolution of April 3rd applying for sanction to borrow £10,400 be rescinded, and that instead application be made to borrow £11,447 10s. 9d., £3,787 10s. 9d. for expenditure on electric lighting account, and £7,660 for proposed extensions to the electricity supply works.

Bury St. Edmunds.—An inquiry was held by Mr. W. E. C. Mead, L.G.B. inspector, last week, into an application by the T.C. for leave to borrow £12,000 for electric lighting purposes.

Derry.—The T.C. has decided to adopt a report of Sir W. H. Preece on the electric lighting of the city, and to apply for a loan of £35,000.

Dumfries.—A report submitted to the T.C. by Mr. Ritchie, Edinburgh, on a proposal for generating electricity by water power on the Cargen Burn shows that 500 H.P. could be made available by storage.

Eastbourne.—At a meeting of the T.C. on Monday, the tender of Mr. John Every, of Lewes, was accepted for supplying and fixing six large cast-iron transformer chambers at a cost of £554 6s. 6d. During the quarter ending March 31st, there was an increase of 24·2 per cent. in the units sold as compared with the corresponding period of 1900. The Council discussed at great length a recommendation of the E.L. Committee to allow the borough engineer to be paid by Mr. Hawtayne, the consulting electrical engineer, a sum of 1½ per cent. on the new buildings (estimated to cost £90,000) for getting out certain of the plans and quantities. Mr. Hawtayne's commission was 3 per cent., but it was urged that as much of the work had been done in the Council's time, and as the Council had had, as a consequence, to employ extra labour to do the ordinary work, a portion of the money should be returned to the Council. Eventually the matter was referred back to the Committee.

Limerick.—The Borough Council has received sanction to a loan of £22,000 for electric lighting.

London.—Marylebone.—The second reading of the Bill introduced into Parliament to confirm the prov. order issued to the Borough Council by the B. of T., has been postponed, and the Council has decided, with only one dissentient, to purchase the Metropolitan Company's undertaking in the borough on terms to be arranged.

Shoreditch.—The Lighting Committee reported, at a meeting of the Borough Council on Tuesday, with reference to the estimated deficiency on the past year's accounts, that an additional expenditure of £3,133 had been incurred for coal above that prevailing under normal conditions, apart from other items of increased expenditure which had not been anticipated. The Committee recommended that the maximum demand rate of 5d. per unit for the first two hours and 2d. per unit afterwards be maintained; the all-round charge be raised from 4½d. to 5d.; the scale of from 2d. to 4d. per unit for large consumers be advanced to 4d. per unit to all customers using 50,000 units or more per annum; and the scale of from 1½d. to 2d. per unit for power purposes be increased to 2d. per unit. The increased revenue which, it was estimated, would result from the revised scale of charges, would amount to £1,856. The recommendation was agreed to. An expenditure of £175 was sanctioned for the purchase of 25 2½-ampere meters and 25 5-ampere meters, and it was decided to extend the sub-station in Evelyn Street at a cost of £400.

Lyndhurst.—The B. of T. has issued a prov. order for electric lighting to the Lyndhurst Electric Lighting and Traction Company, Limited.

Manchester.—At the last meeting of the City Council, Dr. Bishop said that Messrs. C. S. Allott & Son had been appointed to prepare specifications for the buildings required at Stuart Street station. A large proportion of the plant was expected to be ready for providing current by May of next year. At a meeting of the sub-committee, a resolution was come to, with the advice of Dr. Kennedy, that a deputation should visit various manufacturers of electrical machinery such as it was necessary to acquire. Three-phase plant had not been adopted in this country, and when the Manchester station was completed, it would be the best three-phase station in the world. There were only three or four firms in Europe who would be in a position to tender for the electrical portion of the work. The whole question was one of speedy delivery and erection, and it was considered desirable that a deputation should be sent who would report to the Council as to which firm, in their opinion, would be most likely to turn out the work to time. The

deputation would consist of four members of the Committee. Tenders must be in by May 14th, and Dr. Kennedy was very desirous that anything that had to be done should be done before that time. He would be ready within three days of that date to make a recommendation to the Committee. He desired to say also that, contrary to the expectations to which he gave utterance at the last meeting of the Council, it would be the end of the month, and possibly a few days later, before the Committee would be in a position to run any cars, so far as the supply of electric current was concerned. He was glad to be able to make the announcement that they could have run the cars to-morrow if the Board of Trade had made their official inspection, and he hoped they would be running 10 days hence. They could run them as soon as the Tramways Committee were in a position to allow them to do so.

Middleton.—At a L.G.B. inquiry held last week by Captain Luard, into an application to borrow £21,592 for electrical purposes, it was stated that the Corporation had entered into a contract with the British Electric Traction Company, who were constructing a tramway through the district, to supply them with electrical power, thus necessitating the extension of the plant. There was no opposition.

Roumania.—The central electric lighting station in the town of Jasay, which is at present supplying current to 190 arc lamps and 10,300 incandescent lamps, is about to be further extended.

Shanklin.—The ratepayers have cast a majority of votes in favour of lighting the streets by electricity.

Shipley.—Mr. S. D. Schofield has been appointed electrical engineer to the District Council.

South Shields.—The resignation of Mr. Jeckell was announced with regret at the last T.C. meeting, and the Electric Committee recommended that they should advertise for a successor at a salary commencing at £350 per annum, rising £50 per annum to £500 per annum, with the privilege of taking not more than two pupils at any one time and receiving the premiums to be paid by them. The report was adopted.

Spain.—A central electric lighting station has just been completed in the town of Villafranca de la Sagra (Toledo province). The plant was supplied by La Sociedad Industria Electrica, of Barcelona.

Sugar Factory.—A dynamo of 70 H.P. to drive a large new sugar grinding plant has just been put in at the Excelsior Confectionery Works (Messrs. B. Bullock, Limited), Dewsbury. In this department there is an output of about 20 tons per week. Electricity is also used for the tin-making and stamping machines. The firm has also in use an installation of two 400-light dynamos for lighting the works, three motors of 60 H.P., and one 50-KW. generator.

Train Lighting.—In summing up a most interesting paper on "Train Lighting by Electricity," read before the St. Louis Railway Club, Prof. G. D. Shepardson presented some data as to the cost of train lighting, which we give below. The paper was an admirable treatment of the whole subject. The following are the figures he cited:—

The report of Pohl (*Archives fur Post und Teleg.*, 1898; *Elektrotechnische Zeitschrift*, February 24th, 1898; Vol. XIX., p. 121) tabulated the cost of lighting 627 mail cars, whose batteries were charged at nine stations, to be 3·5 pfennig ($0·00875) per hour per 12-C.P. lamp. He concludes: "Electric lighting costs scarcely more and probably less than gas."

A report by Pohl in 1896 (*L'Electricien*, August 1st, 1896) was that gas cost $0·010 per 12-C.P. lamp per hour, while electricity cost $0·008 for equal light, a saving of 21 per cent.; this on the basis of electricity costing $0·04 per KW.-hour.

A report on battery-lighted trains between Paris and Lisle gives the cost as $0·0048 per 10-C.P. lamp-hour (*Railroad Gazette*, 27 - 611, September 13th, 1895).

A report from a road 280 miles long, running out from Adelaide, Australia, with axle-lighting equipments, states that the cost is $18.43 per week per five-car train, against a previous cost of $20 per week with oil lamps. (*Railroad Review*, 1895; *Western Electrician*, November 23rd, 1895.)

A report by Buëttner (*Elek. Anzeiger*, August 28th, 1897; *Engineering Magazine*, August, 1897; *Elec. World*, 30 : 196) states that gas is cheaper for short runs, while electricity is cheaper for long runs.

A report by New (London *Electrical Engineer*, June 28th, 1895) gives a cost of $0·00372 per 17-C.P.-hour on a battery-lighted train in North Staffordshire, England.

A report from the Jura-Simplon Railway (*L'Eclairage Electrique*. 12 : 552-362, 1897) is that the total cost of electric light by storage-battery system is 00·31 fr. ($0·0006) per 10-C.P.-hour, which must include a misplaced decimal.

Kohlfurst (*Schweiz. Bauzeit*, March 31st, 1900) states that the cost of a 10-car train with 10-C.P. per car, for six hours, is for each 10-C.P. $0·0176 from storage battery, $0·0056 from oil lamp, and $0·0026 from axle-driven dynamo.

A report in *Railroad Gazette* (28 : 519, 1896) gives cost of Pintsch gas as $1·085 per car-day, $0·944 for storage battery, and $0·55 for oil, on the basis of equal amounts of light.

A report on the Stone axle-lighting system, used in English trains (*Railroad Gazette*, September 16th, 1898) gives the cost at $0·00294 per 16-C.P.-hour, including all expenses, which was only one-third the cost to them of Pintsch gas.

Another report from the London, Brighton and South Coast Railway in England (London *Electrician*, 33 : 69, May 18th, 1894) gives as the first cost for equipping a train of 10 coaches (English) including its share of the charging plant: For gas $3,500; for oil, $600; for axle-lighting system, $2,000. The yearly cost of maintenance is given as: Gas, $600; oil, $350 to $650; axle-driven electric, $250. At the same time they report 15 per cent. more work obtained from the electric-lighted trains.

The above figures are simply quoted from published accounts. The writer had not had opportunity to verify or analyse them. The indication is that for equally good illumination the electric light can compete with oil or gas in point of economy, while its general advantages leave it far ahead.—*Electrical World and Engineer.*

Watford.—The T.C. has resolved to apply to the L.G.B. for leave to borrow £31,000, to carry out the electric lighting works proposed by Mr. Colebrooke, chief electrical engineer, and approved by Messrs. Preece & Cardew. The tenders of Messrs. Ferranti for switch gear at £733, and for 12 junction boxes at £210, were accepted.

Waterford.—The B. of T. has agreed to grant a prov. order for electric lighting to the Corporation.

ELECTRIC TRACTION NOTES.

Batley.—The L.G.B. having sanctioned the borrowing by the Corporation of £52,451 for the purpose of the Batley tramway order, the engineers have been instructed to get out specifications with a view to tenders being invited.

A Big Scheme.—King Leopold is credited with the intention of inaugurating a vast project for creating a great Belgian and international network of electric railways. According to a Brussels correspondent of the *Express*, the King of the Belgians has been negotiating with the French Government and financiers for the formation of a company, with a capital of £40,000,000, to carry out his scheme, according to which the first electric train would run from Brussels to Antwerp, the second Brussels to Ostend, and a third from Brussels to Paris.

Birkenhead.—Matters affecting the electric tramway system occupied the attention of the Birkenhead Town Council at their monthly meeting on Wednesday of last week. Dr. Pearson supported a recommendation of the Tramway Committee that 15 new cars be obtained and the generating power be increased. The cars were estimated to cost £13,000, and the new generating plant, which included a steam engine and two boilers, £7,500. After discussion, it was decided that the matter should be dealt with at a special meeting of the Council.

Cardiff.—There were 41 tenders submitted for the overhead equipment of the Corporation tramlines. They are now being scheduled and tabulated.

Cheshire.—The Light Railway Commissioners sat at Northwich on Saturday and considered an application for authority to construct a light railway from Northwich to Warrington, with an extension embracing Barnton and Winnington. The scheme affects a population of 90,000, and will cost £120,000. Passengers and goods will be carried, and important agricultural and industrial centres will be connected. The Commissioners intimated that they would recommend the Board of Trade to grant the order.

Dublin.—The case of J. H. Mack *v.* Dublin and Lucan Electric Railway Company, which was a claim for damages for injuries caused by one of defendants' cars to a carriage and horses, the property of the plaintiff, was settled by payment of £300 in full discharge of the claim.

Durban (S.A.).—The Town Council have instructed their solicitor to prepare a Bill for a loan of half a million, which is to include £120,000 for the extension of the electric tramways and £75,000 for the extension of the electric light.

Gateshead.—Colonel Von Donop, for the B. of T., inspected the electric tramway on 1st inst., but the Mayor and Corporation protested against any public service until the trolley wires were made electrically dead on breaking.

Germany.—It is stated that the experimental electric express train of two cars to be run on the Military Railway between Berlin and Zossen will be worked by three-phase current at from 10,000 to 12,000 volts, supplied to four motors on each coach capable of furnishing 3,000 H.P A maximum of 200 kilometres an hour is anticipated.

Lincoln.—The Electricity Committee is pushing on the work in connection with setting on foot an electric tram service. The poles are being erected. The Committee has received sanction to borrow £1,679 to be spent in preliminary matters. Mr. Stanley Clegg, of Darwen, takes over the sole charge of the electricity works from Mr. Vesey Brown on July 6th next.

(*Continued on page* 807.)

THE GLASGOW EXHIBITION.

The people of Glasgow were taken up with one thing, and that alone, on Thursday last week. All parties seem to have joined hands with the manufacturers of this and other countries to ensure the success of the great International Exhibition of 1901, which is fittingly announced as the first great exhibition of the twentieth century.

To record the thousand and one impressions on a like variety of subjects which occurred to us, during the performance of the opening ceremony by the Duke and Duchess of Fife on behalf of the King, hardly falls within our province as a technical journal, and we will therefore refer to them only in the briefest possible terms.

From a photo by] [T. & R. Annan & Sons.

Glasgow International Exhibition.

The musical arrangements were executed in admirable style by the Glasgow Choral Union and the orchestra of the Royal Engineers, and afforded an amusing proof that the patriotism of the Scottish folk would be hard to beat. It had been arranged that on the arrival of the Royal party in the Concert Hall the national anthem should be rendered by the 4,000 there assembled. But the signal was given a little too soon, the arrival of certain officials being mistaken for that of the Duke and Duchess. It was not discovered until the end of the anthem that a bungle had been made. Almost immediately thereafter the Duke and Duchess came into view; then once more the organ led off and the whole audience rose as one man, and for the second time, but with unequalled gusto, rendered the great chorus "God save the King." A dedicatory prayer invoking the heavenly benediction, a long address to the Duke and Duchess a brief reply, and other interesting incidents of the usual character, and then, to the accompaniment of great guns without and cheers and counter-cheers within, the Exhibition was declared open.

The full story telling of all these things has doubtless appeared in many another print, and interesting reading it should be. We ourselves naturally take a greater interest in the exhibits of the various sections in so far as they have any bearing upon the electrical engineering and engineering industrial trades. Of prime importance is the fact that the Exhibition is international. We do not doubt that before it closes it will have been visited by many thousands of foreign visitors, before whom it is in the interest of British manufacturers to keep themselves very prominently in evidence. On the opening day, with the broad Scotch and a dozen foreign tongues to be heard in all directions, a plain Londoner could not but consider the place a veritable Tower of Babel, an indication of its importance, if we have any true appreciation of the foreign trade question.

From our point of view the main interest of the Exhibition lies within the four walls of the Machinery Hall, although, of course, in the lighting of the Exhibition buildings and grounds generally, and in the Industrial Hall, electrical work has excellent representatives. In the Machinery Hall most of the exhibits are quite complete, so far as the exhibitor himself can make them, but some of the large generating sets, which are to furnish lighting and driving power, are not yet running, so that many a motor lies idle, and many an arc lamp remains unlit.

In our next issue we hope to give a general article, indi-

cating in a brief and preliminary way who is exhibiting, and what is to be seen; but we must say that after making a call at the majority of the stands in the machinery department, we are glad to find such a large number of English electrical manufacturing firms so strongly, and in so many cases so ably, represented. We believe that if proper attention be bestowed upon making the exhibit successful in a thoroughgoing business manner, exhibitors will be well repaid for the trouble and expense to which they may be put. We have not the least hesitation in saying that the Machinery Hall contains such a collection of machinery, electrical and otherwise, as has never before been brought together within the United Kingdom. If this fact gets to be widely known, then exhibitors may expect to find as inquirers at their stalls just the men they want to get into touch with, instead of having a crowd of those who only want to see the wheels go round.

Undoubtedly the chief feature in the domain of electrical engineering is noticeable when one institutes a comparison between this year's exhibition and that of 1888; we refer to the transmission of power by electricity for driving machinery. We are informed that at the last exhibition there was only one exhibit driven by an electromotor, namely, that of the Singer Sewing Machine Company, which was fitted out and run by Mr. Rankin Kennedy with dynamos and motors of his own manufacture. This year there is a very different state of things, as we shall shortly show.

From a Photo by] [T. & R. Annan & Sons.

Glasgow Exhibition.

COAL AND ASH HANDLING, AND STORAGE PLANTS FOR ELECTRIC LIGHT AND POWER STATIONS.—III.

Comparing the two great agencies for artificial lighting manufactured at the present day, viz., electricity and coal gas, the value of the residuum of the fuel used in each case is directly opposite.

In the first it is ash and clinker (which invariably is a costly item to get rid of), and in the second instance it is coke—a valuable commercial asset, for which there is a market.

As regards the question of handling these materials, it is of equal importance to do so in small quantities and continuously, by means of conveying plant, in preference to handling in bulk, as a minimum of labour only is required to attend to the apparatus. When designing a works, one should naturally allow (as far as possible) for a future introduction of the latest improvements in machinery to suit the local conditions and regulations, and to obtain the power and light at the cheapest cost.

Conveying machinery for ash plants does not always pay a return for the capital outlay expended when only one or two boilers exist, but due provision should be made in the design of boiler houses, so that when further boilers are added, costly structural alterations are unnecessary.

It will be interesting to our readers to know what is being done in collieries, gas works and chemical works, where hundreds of tons of hot coke, hot ashes and clinker are automatically handled every day. Although the exact designs of these plants may not be applicable in their entirety to electric light and power stations, it must be remembered that a slight deviation is all that would be required.

The principal residual product of coal after being carbonised either in coke ovens or gas retorts is hot coke, and this is withdrawn from the retorts or ovens by the stokers every four to six hours; consequently, with a large battery of these ovens, it will be seen that the work of the stoker or attendant is intermittent.

One of the worst substances to handle is the clinker from boilers, gas producers and furnaces, but it has been found that by the introduction of conveying machinery the wear and tear is about the same as when handling coal. In the new patent process which we now illustrate, the hot coke is delivered direct into the conveyers at the rate of about 20 tons per hour each, and is quenched within a distance of about 20 ft.; the conveyer, therefore, eventually deals with cold coke. The length of these conveyers is about 250 ft.

The photographs shown are for the purpose of illustrating more clearly to the reader the method of dealing with this material.

Fig. 1 is a view showing the hot coke conveyer inclined at an angle of about 20°, and also shows a large detailed view of the style of chain and bars adopted. The chain is 18 in. pitch, and is made up of a series of double solid steel links connected together by distance pins. Between the links and at intervals of 1 ft. 6 in. are fitted 5 in. diameter cast-iron rollers, and in every other link, or at distances of 3 ft., strong 3 in. × 3 in. × ½ in. steel tee bars are inserted between the two strands of chain. The composition therefore of this drag chain consists of two strands of steel chain with intermediate distance or drag bars. We may here mention for the purpose of reference that the bars are 1½ in. from the bottom of the cast-iron trough, so that the whole conveyer when moving runs upon the cast-iron rollers, and thus shows a great improvement upon the old

Fig. 1.—Hot Coke Conveyer.

style of chain, which scrapes along the bottom of the cast-iron trough and entails excessive friction.

The material is delivered by these conveyers on to a steel flat tray conveyer shown transversely across the photograph ; the return chain is carried overhead, and runs upon two light angle irons, as shown upon figs. 2 and 3.

On fig. 2 a general view of the storage yard is shown, with two of Graham's patent hot coke conveyers in working order. There will be noticed in the three views, figs. 1, 2 and 3, the heavy sections of cast-iron trough, and in figs. 2 and 3 the continuation of the trough in connection with the other distributing conveyers. The bottom of the trough is in one piece, and easily renewable, and all guide paths are likewise.

Fig. 2 shows the large storage conveyer, which runs throughout the yard, and receives the material from the two inclined conveyers ; in this view a detail of the supporting structural work will be noticed. This structural work was designed to obtain the greatest efficiency with the minimum possible weight, and the vibration experienced during the working is hardly perceptible. A detail of the head of the conveyers is shown on figs. 3 and 4, where the driving gear is of a larger size. The power to drive this conveying plant is taken from a Crossley gas engine, and transmitted to the head of each conveyer by means of detachable chain belting. This is the simplest form of drive for open-air working, as the weather has very little effect upon the belt, and there is no necessity to cover it, if it is well greased. The driving drums of the conveyers are shown to be geared up to the main drive.

In fig. 3, and in the distance, will be seen a series of storage tanks for the purpose of holding the material. These storage tanks are great economisers as regards the saving of labour, as the carts and railway wagons run underneath them, and receive their loads by merely opening the bottom valves of the hoppers.

As in many works, the yard space is very small ; it will be seen that, by the addition of these large storage bunkers, the regulation of traffic becomes an easy matter, the carts and railway wagons coming in at one gate and going out at another. This advantage alone should recommend the adoption of this scheme, as electric light and power stations are often built in the centre of cities and towns, where the land is too valuable to use the yard as a refuse tip.

The storage tanks are about 140 ft. long × 12 ft. wide × 13 ft. deep, and form one continuous bunker supported by a series of cast-iron columns and joist work.

Fig. 2.—View of Storage Yard.

The thickness of the side plates is $\frac{5}{16}$ in., and the bottom plates $\frac{3}{8}$ in. These are stiffened by a continuous length

of 3 in. × 3 in. angle iron running round the top of the tanks, and on the underside each division is further

Fig. 3.—Head of Conveyer.

strengthened by means of gusset plates and 6 in. × 3 in. channel irons running transversely across the tanks for supporting the conveying plants.

There is a complete gantry running the whole length of the storage conveyers, made of 11 in. × 3 in. deal battens. This platform is supported across the top of the channels, and on the top of the trestle work and intermediately between the trestles by means of $3\frac{1}{2}$ in. × $3\frac{1}{2}$ in. × $\frac{3}{8}$ in. tee irons, thus forming an easy means of access to any portion of the plant.

The storage conveyer, which is about 300 ft. long, consists of an endless strand of joggled steel plates mounted on steel links with special attachments. These trays and chains are stretched tightly over their respective end drums, and supported on the top side by means of cast-iron rollers, shafts and filbows, fixed to the framing. The rollers are pitched about 3 ft. apart, and at the under or return side, the belt will be similarly supported on rollers pitched about 6 ft. apart. The framing of the conveyers is built up of heavy channel iron runners with pillars of similar section, but where it passes over the open space in the yard the side channels are trussed. On this long conveyer is arranged a series of ploughs or throw-offs, as shown on figs. 5 and 6.

On fig. 4 the photograph is taken with the plough lowered on the conveyer, and it will be seen that when the conveyer is in motion the material will be thrown off the conveyer on either side. In the background of this view will be seen a continuous bucket coke elevator. The speciality about this design (described in an earlier article) is that the backs of the buckets touch one another and thus form one continuous movable plate, so as to prevent the coke passing between the chains; the flow of material being regulated by an automatic feeder.

Fig. 5 shows a view of the storage conveyer fully loaded with material, and it will be seen that the ploughs which are not in operation are lifted over the belt.

The description of the elevator can be summarised as follows:—It is 18 in. wide and 44 ft. centre to centre, and is provided with a continuous series of overlapped buckets with the necessary adjusting screws, sliding blocks, sprocket wheels, and collars, together with a built-up boot, top fittings, and the necessary pedestals, all bolted to the channel iron structure forming the apparatus.

The general detail of the framing consists of four angle iron runners stiffened by means of wrought-iron bracing, and on the return side of the elevator the complete casing is arranged for encircling the return buckets.

The chain is of the improved steel roller type for reducing the friction on the sprocket wheels. At

Fig. 4.—Storage Conveyer.

the bottom of the boot is fixed an automatic feeder, which

provides a regular feed of coal to each bucket, and prevents any choking of the elevator.

No doubt our readers will have experienced a series of drawbacks in feeding elevators when there is only one door or slide operated by a man, especially in the case where the attendant leaves the slide, and an extra amount of small coal passes through into the boot quicker than the elevator can lift it.

This feeder, although of a very simple type, consisting principally of a movable hinged plate, overcomes these drawbacks. On fig. 6 will be seen the delivery of the material from the shoot (on top of the inclined conveyer) on to this steel belt, and also a detail showing the cast-steel links and the top head gear. A view of the coke elevator and screening plant is also shown.

For the purpose of screening the coke a revolving screen, about 10 ft. long, 3 ft. diameter at the small end, and tapering to 6 ft. diameter at the large end, is provided; this screen consists of three rings, on which are mounted strong wire screens, with a mesh ½ in. square, for the purpose of separating the breeze and dirt from the clean coke.

The breeze falls on to the ground, while the large coke is deposited in the bottom of the elevator, and afterwards delivered on to the conveyer (as shown on fig. 3) and carried to the storage bunkers.

For driving the two hot coke conveyers a gas engine is provided, having an effective power of 20 B.H.P., and for driving the tray conveyer, the screen and the elevator there is supplied a gas engine with an effective power of 10 B.H.P., thus allowing a good surplus.

The driving and trailing drums of these conveyers are made of a special design to suit the detail of the links and to obtain a direct grip on the chain, and thus prevent any loss of power by slipping.

Due provision has been made in the elevators and conveyers for the necessary adjustment for any variation in temperature, but it has not been required up to the present time in working this plant, on account of the material being cooled before it travels very far in the length of trough.

The whole of the troughs are water-tight, the surplus water being allowed to run out at the end when the conveyer stops, and by this means the foreman in charge is aware when the sprinklers are inadvertently left running.

The sprinklers for quenching the coke are fixed directly in front of the delivery into the conveyer, but it should be understood that it is not always necessary to have much water in the conveyer trough; in fact, it is much better to work with a maximum depth of about 1 in. merely for the purpose of keeping the trough and chain cool and lubricated.

This plant has been running now for some considerable time; it works very smoothly and is practically noiseless.

Inside the cast-iron trough are patent deflecting plates for the purpose of protecting the chain when delivering the material either hot or cold into the conveyer.

Although the photographs show the conveyer open when passing into the yard, when working in the boiler house or retort house suitable lids or covers are provided, which thus make the conveyer a continuous and closed trough; by this means the steam, fumes, smoke and dirt are prevented from coming into contact with any other apparatus in the building.

Vertical shafts, exhausters, blowers, &c., are provided where necessary to exhaust the steam. The trough can also be provided with ducts, which can be inserted into the chimneys to obtain the necessary draught.

This plant was erected under Maurice Graham's patents by Messrs. Graham, Morton & Co., Limited, Leeds.

THE GENERATION AND TRANSMISSION OF ELECTRIC ENERGY AT AND FROM COAL PIT CENTRES.

By B. H. THWAITE, C.E.

(*Continued from page* 608.)

Progress of Power Generation and Distribution.

Other innovations of a minor character have been made, and in their culminating effect they have raised the efficiency and increased the usefulness and safety of alternating and high pressure systems of electric energy distribution. As an example of such minor improvements, the following description of a modern monophasic distributing installation, including the most advanced features, will no doubt be interesting.

Fig. 5.—Coal Handling Plant.

A Modern High Pressure Distributing Equipment.—This installation supplies some 22 different communities in the Grand Duchy of Baden with electric energy from a central power station situated at Wiesloch. The Electricitäts Aktien Gesellschaft (Lahmeyer & Co., Frankfort) are responsible for the entire arrangement, and for the interesting innovations to be described.

The electric energy is not only supplied to satisfy all the

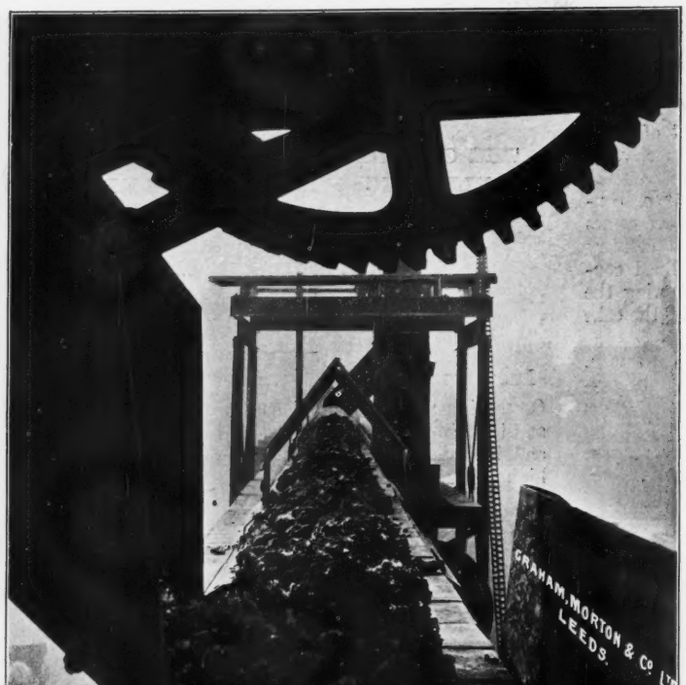


Fig. 6.—Coal Handling Plant.

lighting and power requirements, but is intended to supply the electric railway, 14 kilometres long, connecting Heidelberg with Wiesloch; for the latter purpose a sub-station at Liemen is provided with two 60-KW. converters, to convert the high potential alternating current into continuous current at 650 volts.

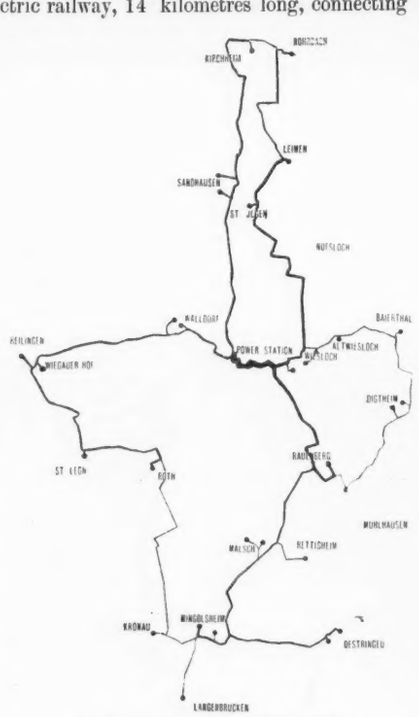


Fig. 1.—Map of Supply Area.

Character of the Distributing Area (see fig. 1).—The 22 communities are situated on both sides of the German State railways, and are fairly evenly located around the generating station. The total length of the main line is 87 kilometres (54½ miles); the greatest direct distance from the generating station is 12 kilometres (7½ miles). The pressure on the main line is 10,000 volts.

Generating Station.—The electric plant is driven by three horizontal tandem condensing engines, two of which are rated at 375 H.P. and the other at 180 H.P.; they all run at a speed of 90 revolutions per minute.

The engines are directly coupled to alternating machines, two of 300 KW., and one of 130 KW. The electric generators have fixed armatures, and rotating inductors which constitute the fly-wheels of the engines.

The alternators have a working pressure of 10,000 volts, so that the current can be delivered direct to the line. Fig. 2 is an external view of the engine house, and fig. 3 is a general view of the engine room. Fig. 4 is a section of the complete machine. The high pressure winding is encased in micanite tubes; protecting plates are provided to avoid the possibility of accidental contact. The makers devoted special attention to the design (1) to avoid drop of pressure; (2) to permit the generators to be readily put in circuit, so as to work in perfect synchronism.

Pressure Regulation.—The regulation of the pressure is entirely controlled by the shunt regulator of the exciters; the saturation of the exciters is so fixed that the pressure of the current generated by them remains for all practical purposes sufficiently constant, even if the load varies. The switchboard is shown by fig. 5; the line connections to it are shown in fig. 6. All the electrical measurements are made on a low pressure circuit.

Fig. 7 shows graphically the method of putting the electric generators into circuit. One coil of each electric generator is detached, and is connected not with the armature winding, but with the primary winding of a transformer, the secondary winding of the latter being connected in series with the armature winding of the electric generator.

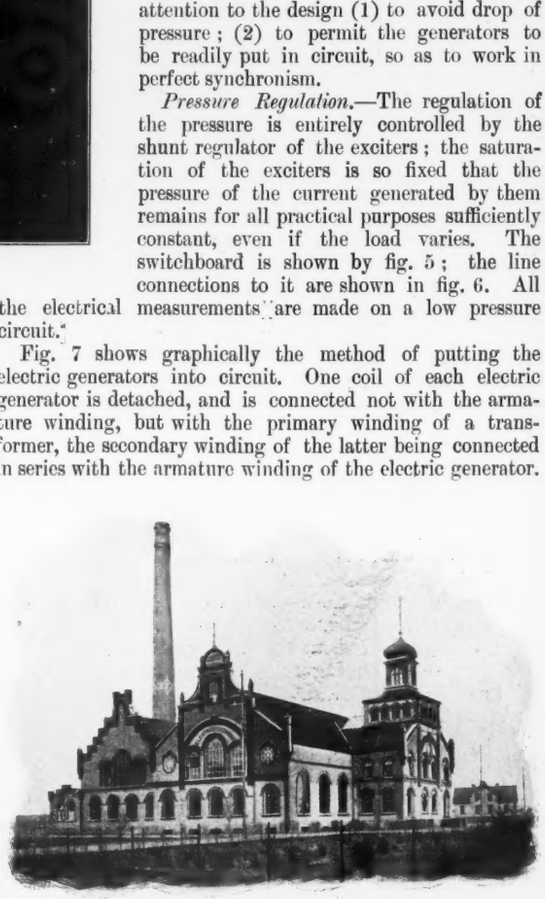


Fig. 2.

The transformer winding is arranged for a transforming ratio of 1 to 1, so that the primary and secondary currents are equal; the generator current can consequently be measured by means of an amperemeter, A, switched on the low pressure circuit.

Measuring Equipment.—The pressure is measured by means of a voltmeter, V, connected to the separated coil on

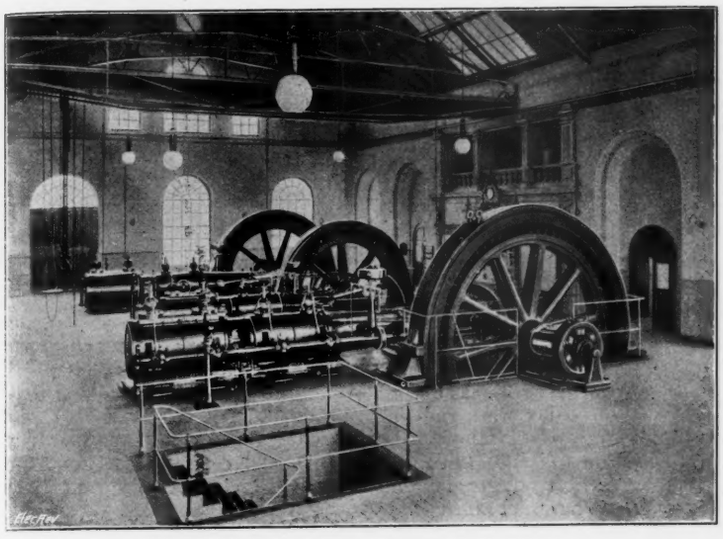


Fig. 3.

the electric generator, the total pressure, of course, being ascertainable by multiplying the coil pressure by the number of coils.

Wattmeters, electricity meters, and phase lamps, can also be switched on to the auxiliary circuit. The instruments and apparatus used in connection with parallel-circuiting are kept, by this arrangement, entirely away from the high pressure winding.

The high pressure switches are located on the upper half of the switchboard, and are actuated by means of an insulated rod. In order to prevent any accident, the precaution has been taken to provide an earth connection at one point in the current measuring circuit, so that should the high pressure current by any possibility pass into the measuring circuit, there would be no danger to the *personnel* of the station. The measuring apparatus, as well as the high pressure connections of the electric generators, are located in a chamber in the foundation.

In addition to the measuring instruments specified, two static voltmeters are mounted on the switchboard, these being connected in series, with their connecting point properly earthed. Under ordinary conditions each voltmeter indicates half the total pressure, whilst on the wire earthing, one of the high pressure voltmeters would indicate the whole pressure, the pointer of the other voltmeter falling at the same time to zero. Messrs. Lahmeyer & Co. claim that this is the first installation to their own knowledge in which static voltmeters have been used as earthing testers.

The high pressure current distributing equipment is located well away from the main switchboard, and directly under the entrance of the feed conductors into the conductor tower ; the distributing apparatus is shown in fig. 8.

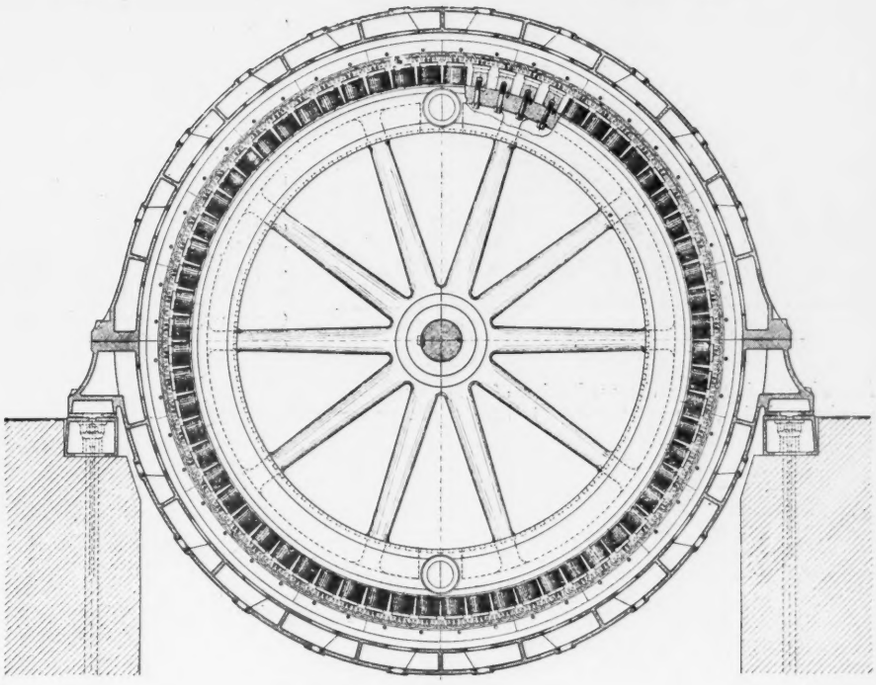


Fig. 4.

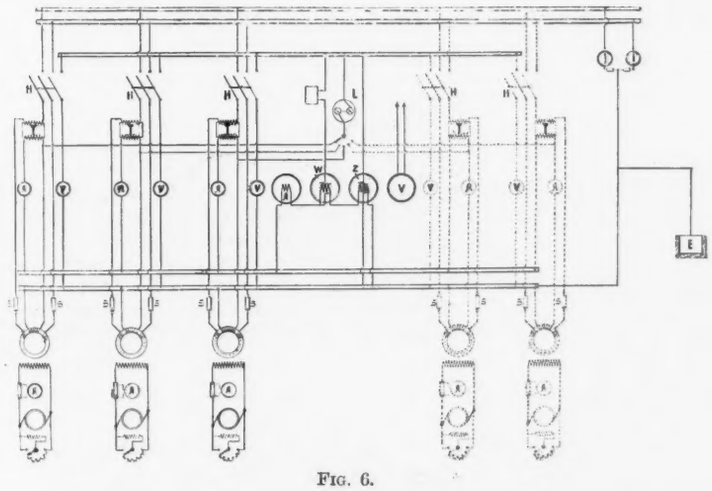


Fig. 6.

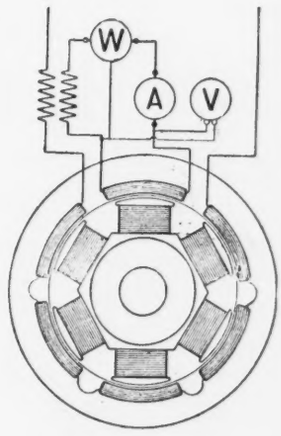


Fig. 7.

The problem of obtaining a fusible connection, which, whilst being precise in its working effect, would nevertheless

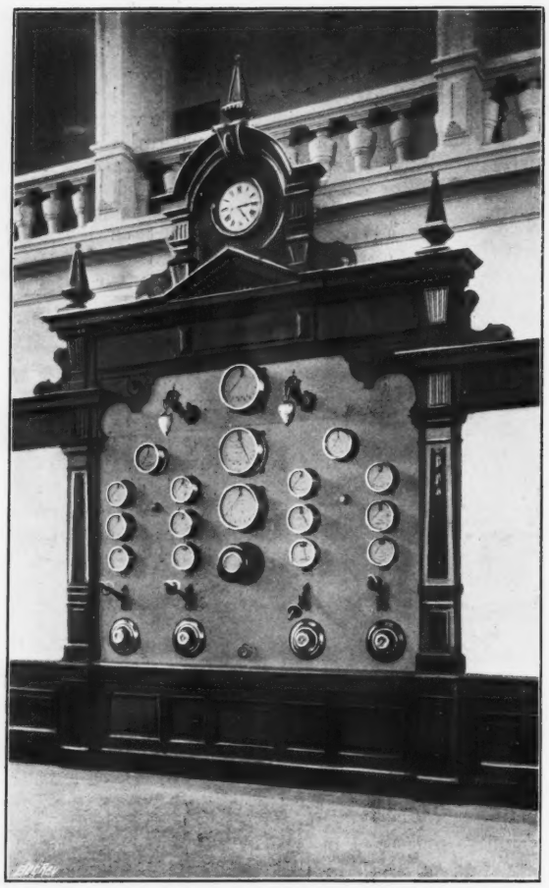


Fig 5.

fuse without involving the production of a noisy explosion, was not found to be of easy solution. However, Messrs. Lahmeyer succeeded in solving the problem in the following way :—The two ends of the main fuse wire are provided with a spring device that separates them widely immediately the fusion takes place, and prevents the formation of an arc. The effect of the Lahmeyer combination when the fusion occurs is a sharp report, but there is no tendency towards flame

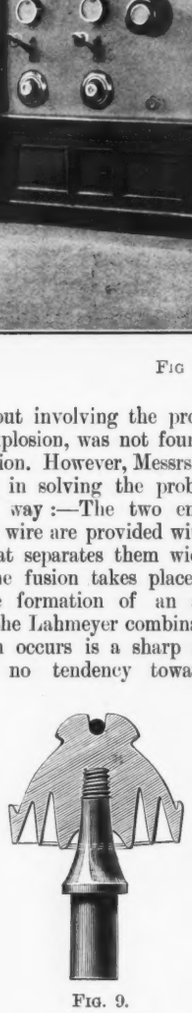


Fig. 9.

forming. The system has, it is said, proved satisfactory wherever applied.

Line Safety Arrangements. — Horn lightning arresters are connected with the aerial high-pressure conductors at a position *just before* the latter emerge from the conductor tower.

The lightning conductors — one to each pole—are fastened by means of hoops, and are connected to earth. Choking coils are fitted between the lightning conductors and the safety connections, as shown in fig. 8; the object is to prevent the lightning discharge from flowing into the electric generators.

The Line.—The main distributing high-pressure aerial conductors are arranged on the ring system, and pass through the entire number of the communities. Energy is supplied to the main line at five different points.

The aerial high-pressure line does not pass over the inhabitated part of the supply areas, the transformers feeding the low-pressure mains being in nearly every case located on the outskirts of each district.

At Wiesloch, however, it was found to be absolutely necessary to establish a transformer station within the town limits, and the high-pressure line passes near to or through the habitable district. The main line is carried on poles some 40 to 46 ft. high, triple petticoat or bell insulators being used (fig. 9). The main service is equipped with lightning protecting wires and lightning conductors. The lines that pass over the main roads are equipped with catching forks, firmly clamped to the wooden poles, and connected with earth, so that, should a wire break, the broken conductor would at once be earthed.

At street crossings and where the line passes over telephone and telegraph wires protection nets are provided.

Arrangements are made that permit the current to be cut out from each section for repairing or testing purposes.

(To be continued.)

American Engine Combination.—Reuter's New York agent telegraphed last week that a combination of manufacturers of stationary engines has been effected by the formation of the Allis-Chalmers Engine Building Company, comprising four of the largest machine shops in the world, namely, the E. P. Allis Company, Milwaukee ; the Fraser and Chalmers Company, Chicago and London ; the Gates Iron Company, Chicago ; and the Dickson Manufacturing Company, Scranton and Wilkes Barre. The capital of the combination is $32,500,000. Allis, where art thou ?

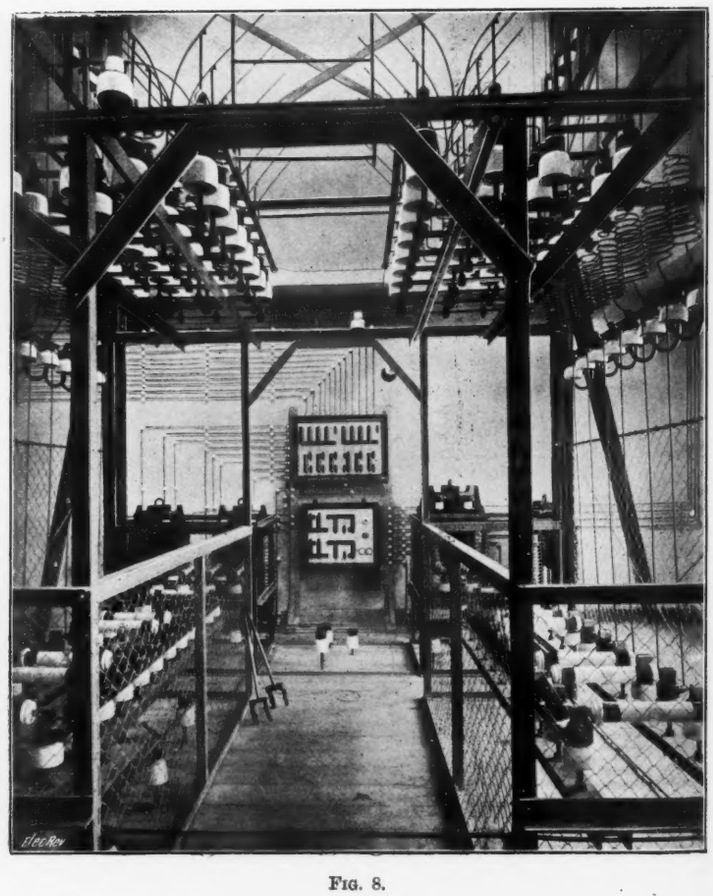


Fig. 8.

ELECTRIC TRACTION NOTES.

(*Continued from page* 798.)

Liverpool.—The report of Mr. Trotter, Government inspector, upon the overhead wire accident which took place a short time ago in Liverpool, has been issued. The inspector mentions eight causes as conducing to the accident, viz., the heavy fall of snow; the failure of the wood guard; the number of telephone wires, and the length of the span; the salt slush on the road; the darkness, which rendered the wires invisible; the interruption of the telephone service; the delay in cutting off the electric current, and the inadequate length of the wood guard. Referring to the report at a meeting of the Liverpool Tramways Committee, Mr. Austin Taylor remarked that, as far as he could judge, the report was reassuring. Guard wires are now being put up at points on the Liverpool electric car routes where the postal telegraph or telephone wires are carried over the electric trolley wires. The National Telephone Company are hastening the work of placing their wires underground in the Liverpool district. At a meeting of the Liverpool City Council last week, Mr. Austin Taylor stated that during the last two years the National Telephone Company in Liverpool had spent over £100,000 in placing their wires underground.

At the meeting of the Tramways Committee last Friday a report was submitted by the general manager (Mr. C. R. Bellamy). It showed that the receipts for the fortnight had been £17,790 7s. 5d. against £15,789 5s. 1d. in the same period of last year, an increase of £2,001 2s. 4d. The mileage run had been 394,452, compared with 332,049 in the corresponding weeks last year, an increase of 62,403. The number of passengers carried was 3,844,281 against 2,953,863 in the corresponding fortnight last year, an increase of 890,418. 290 electric cars and seven horse cars were at work, against 107 and 189 respectively last year. Referring to the report, Councillor Lloyd pointed out that the number of passengers carried during the fortnight was equal to that of the previous fortnight, which contained two exceptional holidays. It approximated to four millions, showing that as regards the number of passengers carried, the electric cars were now carrying the entire population of Liverpool about three times a week.

The Tramway Committee of the Liverpool Corporation have appointed stopping places for the electric cars. Special notice plates have been prepared for use at the stopping places. They bear such intimations as: "All cars stop here," "Cars stop here by request," "Cars going south—or north—stop here," and similar notices. The letters are enamelled, and the notices project from permanent pillars.

The Tramways Committee have decided to recommend to the Council that an application be made to the B. of T. for sanction to borrow the sum of £319,000 for the purpose of carrying out works authorised by the Corporation tramways extension orders of 1898 and 1900.

Merthyr.—The Merthyr Electric Traction and Lighting Company, Limited, on Friday afternoon entertained to luncheon at the Bush Hotel, Merthyr, a large company of gentlemen chiefly representing the local constituencies of the county councils of Glamorgan and Brecon and the various district councils in the Merthyr, Aberdare, and Rhondda Valleys, in celebration of the opening of the Merthyr light railways. Mr. Emile Garcke presided.

The Metropolitan Railway and Electric Traction.—The *Daily Chronicle* understands that the Metropolitan Railway Company have now made formal application to the Board of Trade for permission to introduce the Ganz system of electric traction over their portion of the Inner Circle. Until the decision of the Board has been received no action will be taken by the Metropolitan District Company. If the Board refuses to sanction the system both companies will apply for authority to adopt the American system. That course has been agreed to as a settlement of the difference of opinion between the two companies with regard to the best method of introducing electric traction.

Middlesex.—The Light Railway Commissioners have submitted to the B. of T. for confirmation the County of Middlesex Light Railways Order.

Milan-Monza Electric Tramway.—The electric tramway which has been installed by the Italian Edison Company between Milan and Monza is divided into two sections, one from the power station at Sesto San Giovanni to Loreto, and the other from Loreto to Monza. The first section is supplied with current by a short feeder at a point near the power station; the second section is supplied by two feeders, one connected with it near the power station, and the other at a point 6 kilometres distant. There are six lines, each consisting of three conductors, from Paderno to the power house, on any one of which alternating three-phase current may be received at a pressure of 13,200 volts. The three conductors of the line selected for supplying the station are led to a high tension switchboard, from which they are connected with the stationary transformers; the low tension leads from the latter are connected with the low tension boards, and then go to the rotary converters. The stationary transformers, of which there are three, each of 150 KW., were supplied by Ganz & Co. They reduce the pressure of the alternating three-phase current from 13,200 to 350 volts. At this pressure the current passes into the rotary converters, and issues from them as a continuous current at 550 volts. These machines do not consist of a three-phase motor coupled on the same shaft as a continuous current dynamo, but are true converters, in which a single inducing field serves for the armature of the three-phase synchronous motor and continuous current generator. They are made by the General Electric Company, and the two used are of 200 KW. each. Leads from the rotary converters run to a continuous current switchboard, on which are mounted the necessary measuring instruments, switches, &c., and from which current is supplied to the three feeders. Of these the two short ones feed the line direct, whilst the third, which runs to a distant point, supplies current, the pressure of which has been raised from 550 to 760 volts by means of one of the two boosters at the works. These machines have a capacity of 32 KW. each, and consist of an asynchronous induction motor driven by the low tension three-phase current furnished by the Ganz transformers, and a continuous-current generator mounted on the same shaft. The peculiarity of these machines, in so far as they act as continuous-current dynamos, is that they may be excited at will, either in series, or in shunt. In the former case they raise the pressure of the continuous current from the converters, thus producing an automatic regulation of the pressure; in the latter case they are used during times of slackness (that is, when no account need be taken of the feeder supplying power to the distant point) to charge the accumulators, which could not be connected with a series dynamo without danger of reversing the polarity. The accumulators were supplied by the Cruto Company, and are capable of giving 800 amperes at 550 volts for one hour, that is, they are capable of double the work normally absorbed in one hour by the installation. The positive plates are of the Majert type, with Planté formation, and the negative plates are of the Pescetto type. The cars are arranged so that they can be fitted in summer with an "imperial," which will enable them to carry 85 passengers. They are mounted on two four-wheel trucks, of which two kinds are being tried experimentally:—(1) The well-known Peckham truck, in which there are two systems of springs, namely, a set of elliptical springs, which support the car when it is empty or lightly loaded, and an independent set of helicoidal springs, which come into play when the load becomes considerable; and (2) the Brill truck, in which the intermediate system of springs is suppressed, but which is based upon the same principle of one set of springs for light, and another set for heavy loads. There are two General Electric motors of 50 H.P. each. These are of the ordinary type, with the usual suspension. The cars are heated by radiators placed under the seats, and are fitted with a hand brake, as well as with an electric one.

Oldham.—It is estimated that the probable amount of electrical power that will be required in order to work the tramway lines which are expected to be opened shortly, will be 900 H.P., but the Electricity Committee will not be able to supply more than 400 or 500 H.P. by the time it is required. The Tramways Committee expect to be running the Lees Road, Glodwick Road, Park Road, and Hollins Road sections by Whitsuntide.

Paisley.—Messrs. Atherton, of Liverpool, have again approached the T.C., and have agreed, in the event of Mr. Murphy's (of Dublin) Bill being thrown out this session, to apply for a prov. order next session. The measure would embrace the same provisions as Mr. Murphy's present Tramways Bill. The Ratepayers' Committee have intimated to Mr. Murphy their intention of opposing his Bill if he should make any alterations to suit the wishes of the Council.

Littlehampton.—A company has approached the Council regarding a scheme for running an electric tramway from Worthing to Arundel, with a branch line from Patching to the corner of East Street, and High Street, Littlehampton. The Littlehampton D.C. will not oppose the scheme.

Russia.—A scheme has been drawn up for converting the horse tramways in the town of Nicolaieff (South Russia) into electrical lines.

Sheffield.—Colonel Herbert Hughes (secretary of the Sheffield Chamber of Commerce), who on Sunday returned from a visit to the United States, stated to a press representative that one thing which struck him was the great superiority of the American tramway system. There was no doubt that the Sheffield tramway system was greatly behind an ordinary installation in comparatively small towns in the States. The cars out there were much larger, probably with 50 per cent. more accommodation, and they ran on bogie trucks, with the result that they dealt with inclines and curves of the severest character at very high speeds, and with perfect safety. The American population seemed to have thoroughly learned to get out of the way of the fast-running cars, and nobody was in the least degree afraid of them. The fares were a good deal higher than in Sheffield. The bulk of the cars charged 5 cents, but in many places a passenger could travel 10 or 12 miles for that sum. In some cases, as the result of political agitation, the fares had been, or were being, reduced to 3 cents.

Spain.—Work has just been completed on the construction of the new electric tramway between Barcelona and Horta. A feature of the power station is that the dynamos are driven by gas engines operated by means of producer gas.

Spennymoor.—A deputation from the United Kingdom Tramway and Light Railway and Electrical Syndicate attended before the Urban Council, and asked permission for running electric trams in the district. It was decided that support of the Council be given to the syndicate for the promotion of a provisional order under the Tramways Act, 1870, for the construction of tramways on the overhead trolley system.

Springhead.—Messrs. Hewitt & Rhodes, consulting electrical engineers, have written to the D.C. stating that it is their intention to apply for powers to provide an electrical tramway from the Oldham boundary at Teesbrook through Tees and Springhead, on to Delph. An interview between the parties has been arranged.

Wolverhampton.—Another meeting of the T.C. in Committee was held on Monday for the purpose of again considering what means of traction should be adopted for the new electric trams. Since the previous meeting, the Tramways Committee had met and had had before them representatives of the Lorain and Dolter systems, when the respective merits of both were carefully considered. At Monday's meeting of the Town Council a revised offer was submitted by the Lorain Company, as follows:—

1. The Lorain Steel Company to agree to lay down their contact boxes, connect same with approved cables (·05 square inch area) laid on the solid system, furnish, erect, and connect up the necessary feeder pillars over and above the two per mile of track included in your cable contract for the sum of £1,600 per mile of single track for the 11·375 miles now under consideration.

2. The Lorain Steel Company to be allowed to lay down their apparatus at the same time that the permanent way is being constructed.

3. The Lorain Steel Company to receive your immediate consent to equip about one mile of double track in Bilston Road within the next 90 days, and furnish three motor car equipments for operating on same, your Corporation undertaking to give these three car equipments a thorough test under actual commercial operating conditions for at least 60 days.

4. At the expiration of 90 days' successful operation of the three equipments over the one mile of double track, the Wolverhampton Corporation to give the Lorain Steel Company official notice to proceed with the equipment of the remaining 9·375 miles of track as per the terms of the contract.

5. In case of any disagreement arising regarding the contract or the meaning of the term successful operation, all such matters to be settled by arbitration consisting of five members, the first the borough electrical engineer, of Wolverhampton, the second a party chosen by the borough electrical engineer and acceptable to the Lorain Steel Company, the third a representative of the Lorain Steel Company, the fourth a party chosen by the Lorain Steel Company and acceptable to the Wolverhampton Corporation, and the fifth a party nominated by the Board of Trade. Each member to have equal voting power, and majority vote to be accepted by both parties and considered final.

6. The Lorain Steel Company to supply a competent engineer during the term of their guarantee.

7. Should the Wolverhampton Corporation desire to equip any portion or all of the remaining track of their system, up to a total of 80 miles of single track, it is understood that the price to be charged by the Lorain Steel Company shall not exceed the price per mile of single track paid for the first 11·375 miles, providing that such equipment is ordered within three years from date of operation of the first three motor car equipments.

8. The Lorain Steel Company to agree to furnish the Wolverhampton Corporation any or all improvements that may be made in their system up to January 1st, 1907, at manufacturing cost plus 10 per cent., and without any additional charge for patent royalties for the use of such improvements.

9. All other terms of contract to be mutually agreed upon.

In telegrams which subsequently passed the company undertook to guarantee the successful operation of the system for one year, assumed responsibility for all accidents due to the system for the same period, and agreed to reinstate paving if the system was unsuccessful and taken out.

Mr. Shawfield, the city electrical engineer, in a letter to Mr. Alderman Mander, said that he could not as a professional man take the responsibility of advising the Council to definitely adopt this system in preference to the overhead system, as this course would commit him to a responsibility for the success of the system which he was totally unprepared to take, without having first seen the system in operation under working conditions for at least one year. He had carefully watched the development of surface contact systems for some years, and had investigated most of the systems on this principle that are now in operation, and was of opinion that the Lorain system possessed many advantages over any other system hitherto introduced. Its principal merits were those of extreme simplicity, fewness of its working parts, and the sound and mechanical design of the contact studs. In fact, it was the only surface contact system that did not contain features which he would expect to prove certain causes of ultimate failure. He could see no adequate reason why the Council should not accept the offer of the Lorain Steel Company, provided always that their guarantees were satisfactory, and that full power is reserved to the Corporation to insist on the removal of the system and the reinstatement of the track.

Mr. E. S. G. Rees has made an expert report upon the merits of the "Dolter" and "Brown" surface contact systems. He says that the two systems are identical in principle, but that the "Brown" system at the present time is far superior to any surface contact system he has seen, and would give less risk of trouble or failure, but he suggested that the Corporation in any agreement which they came to with any company to lay down an experimental surface contact system should guard themselves and their engineer from being forced to take over a plant which after a year's working proved itself to be only a qualified success.

Ald. Mander also stated on the question of expense that the cost of the Lorain system would amount to £24,500 more than the overhead system, and the extra cost per year with regard to repayment would be £1,155. The company, he added, were offering the Corporation to lay down at their own risk and cost a line which would be equal to £20,000 or nothing, and that was quite good enough for him. He therefore moved a resolution in favour of the adoption of the Lorain system of traction, and after considerable discussion it was carried by 23 votes to 14.

The Cape-Australia New Cable.—Reuter last week stated that the work of laying the new cable from Adelaide to the Cape had been begun.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphists Grievances.—On Thursday, May 2nd, a largely attended meeting of telegraphists was held in the Memorial Hall under the auspices of the Postal Telegraph Clerks' Association. In the absence, through illness, of Sir A. K. Rollit, M.P., Mr. R. H. Davis, the chairman of the London branch, presided. He was supported by the Hon. Claude Hay, M.P., Mr. W. C. Steadman, L.C.C., and others. Mr. Thos. Bayley, M.P., and several other M.P.'s who had promised to be present, were kept at the House of Commons by the coal tax debate. In opening the proceedings, the chairman dwelt on the perturbed state of the telegraphists at the present juncture. After reading Lord Londonderry's reply to the deputation of M.P.'s, he said that he thought it was the production of a good man struggling with adversity. The trail of the Treasury was over it all. A large number of letters and telegrams from M.P.'s and the telegraphists of the large towns of Great Britain and Ireland were read. The following resolution was then moved by Mr. Charles H. Garland:—

This meeting of the combined London and District Branches of the Postal Telegraph Clerks' Association protests against the present unprecedented stagnation of promotion at £160 in the Telegraph Service, and urges upon the Postmaster-General the necessity of completing the abolition of classification in the operators' class

In supporting the claim he quoted the instance of a man of 20 years' service who entered under the promise of a prospect of £190. There were 450 men in front of him for promotion beyond the £160 point. Last year 13 men were promoted. At this rate it would take 35 years to clear off those in front, and the man's turn would come for promotion when he had 55 years' service and was 70 years of age. But he would be compelled to retire on the age limit at 60! So the promised prospect was of as little value as the promises of quack medicine vendors or the advertisers of hair restorers! He contended that there had been a flagrant breach of faith. The resolution was seconded by Mr. W. Davis, and supported by Mr. C. E. Hall (Liverpool), Mr. W. C. Steadman, Hon. Claude Hay, M.P., and Mr. J. A. Devaney, and carried unanimously. The chairman announced that an application was being made to the Postmaster-General to grant an interview to three members of the London Branch.

Aberdeen Telephones.—The Telephone Committee of the T.C. fully discussed Mr. A. R. Bennett's report on a municipal telephone system last week. Decision was deferred.

The New Anglo-German Cable.—The *Globe* correspondent at Berlin, writing on 2nd inst., says:—"The German cable-laying steamer *Von Podbielski* has just put out to sea with a cable which is to be laid between the English coast and the island of Borkum, in the North Sea, at the mouth of the River Ems. The cable weighs about 1,150 tons. Commercial circles in Germany have long felt the want of increased intercourse by cable with England. In fact, the inadequate cable system between the two countries has been shown most strikingly for some time past by the fact that the Bremen cotton merchants have been compelled to have their cablegrams from Liverpool dispatched to the United States and thence to Bremen. It was found that the increased cost of the cablegrams was amply compensated for by the great gain in time in receiving the messages."

New Cable.—The shore end of a cable laid for the Commercial Cable Company between England and Ireland was successfully landed at Weston-super-Mare on 6th inst.

Portsmouth Telephones.—Tenders have been received for the Portsmouth Telephone Exchange, and the Corporation Committee having charge of the undertaking, find that these work out at less than the original estimate of Mr. Bennett, the expert consulted, this being £26,500, whereas the accepted tenders are at least £1,200 under that sum. The Committee have decided to recommend the Council to borrow £26,000. The tenders amount to £19,000; various items which will not be tendered for amount to £4,325; and £2,000 is put down for contingencies; making a total of £25,325. The Committee have not in every case accepted the lowest tender.

Western Telegraph Company.—The following appears in the *Financial Times* of the 2nd inst:—

May I call your attention to the way shareholders in the Western Telegraph Company are treated, and ask your assistance on their behalf? By the report received this morning it appears that while the earnings or profits during the last half-year amount to £172,496, the shareholders only get out of this large amount £62,379 as dividends. The enormous sum of £100,000 is added to the reserve fund, which now amounts to over £700,000. The company pays between 6 and 7 per cent., but it could pay nearly 15 per cent. if the shareholders received the full benefit of its profits. The consequence is the shares (£10) only stand on the market at 13¾-14¼. There is an item on page 8 of the report, "To loan, £100,000," but no explanation is given of it; and on the other side page 9, By "Electra House, Limited, payment for 20,000 fractional interests, £20,000," which is not explained. The company pays well, one may say, but my complaint is that it does not pay at all in accordance with its profits, and it is no good going to the meetings unless you are a big shareholder, as you get little or no attention. I have been a shareholder in the company for some years now, and when I first bought the reserve fund was under £300,000, and it has been nearly a million, so I think I have borne my share in it; but what makes me grumble is that the result of the directors' policy lately has been to put the shares down from 16 to 14.—A Shareholder with a Grievance.

CONTRACTS OPEN AND CLOSED.

OPEN

Bermondsey.—May 21st. The Borough Council wants tenders for the wiring, fittings, &c., for the installation at the electricity works and stables. See "Official Notices" May 3rd.

Bradford.—The Bradford Corporation are about to advertise for material for the overhead equipment of the Manchester Road Tramway. They have decided to use Cooper's patent joint rails throughout this route.

Brazil.—July 8th. The Foreign Secretary has received a despatch from H.M. Consul-General at Rio de Janeiro, stating that tenders are invited by the Brazilian Government, to be received not later than July 8th, for the supply of electrical machinery for the hoisting and transporting of locomotives at the Engenho de Dentro Works. Some particulars may be examined at the Commercial Department of the Foreign Office.

Bristol.—May 12th. The Electrical Committee wants tenders for alternating current transformers. See "Official Notices" May 3rd.

Cleckheaton.—May 14th. The D.C. are advertising for tenders for the erection of an electric lighting station and destructor works, to be sent in before Tuesday, the 14th inst.

Clyde.—May 16th. The Trustees of the Clyde Navigation invite tenders for the supply of stores for the year commencing July 1st, 1901. Some of the items are:—(2) Asbestos and packing; (9) Electrical stores; (13) India-rubber; (14) Iron and steel; (15) Iron castings; (20) Oils, &c.; (25) Steam tubing &c. Specifications and forms of tender may be had on application to T. R. Mackenzie, General Manager and Secretary, 16, Robertson Street, Glasgow.

Colne.—May 20th. The Electrical Committee wants tenders for Lancashire boiler, mechanical stoker, superheater, economiser, pump, piping, crane, condenser, motor pump, and motor transformer. See "Official Notices" to-day.

Dundee.—May 11th. The Gas Commissioners want tenders for a 700-H.P. triple expansion steam engine and dynamo. See "Official Notices" April 26th.

Dundee.—May 30th. The Gas Commissioners want tenders for steam piping, &c., for the electricity works. See "Official Notices" to-day.

Dublin.—June 3rd. The Lighting Committee wants tenders for main and sub-station switchboards, transformers, arc lamps and pillars. See "Official Notices" April 26th.

Dublin.—June 3rd. The Lighting Committee wants tenders for switchboards, transformers, arc lamps and posts. See "Official Notices" to-day.

Exeter.—June 14th. The Council wants tenders for water-tube boilers, steam alternators, switchboards, coaling apparatus, tanks, &c. See "Official Notices" to-day.

Fulham.—May 15th. The Council wants tenders for materials for the electric light and dust destructor works. See "Official Notices" April 26th.

Great Eastern Railway.—May 14th. The directors want tenders for the supply of stores and materials. There are 23 different sections, including one for telegraph materials. See "Official Notices" April 19th.

Hendon.—June 5th. The U.D.C. wants tenders for the wiring of the new Council offices. See "Official Notices" May 3rd.

Hull.—May 23rd. The E.L. Committee wants tenders for 12 D.C. street arc lamps, with posts, &c. See "Official Notices" to-day.

Kingstown.—May 30th. The U.D.C. wants tenders for boilers, pumps, piping, economiser, &c.; engines, generators, balancer, and booster; switchboards and instruments; battery; cables, street work, boxes, switch pillars; electric wiring of supply station; electricity meters, demand indicators, and main fuses; arc and incandescent lamps, &c. See "Official Notices" to-day.

Long Eaton.—May 20th. The Council wants tenders for two Lancashire boilers, engines, dynamos, switchboard, &c. See "Official Notices" May 3rd.

Madrid.—June 1st. The Secretary of State for Foreign Affairs has received a despatch from H.M. Ambassador at Madrid stating that tenders are invited by the Spanish Postal and Telegraph Department for the supply of 30,000 zinc cylinders for the service of the Government telegraph stations. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office.

Manchester.—May 18th. The Tramways Committee wants tenders for 5,000 tons of steel rails, 170 tons of fishplates, 110 tons of tie-bars, 35 tons of bolts and nuts, and 5,000 tramway poles. See "Official Notices" to-day.

Motherwell.—May 18th. The E.L. Committee wants tenders for cast-iron lamp columns, arc lamps, switches, fittings, &c.

Plymouth.—May 18th. The Corporation wants tenders for overhead line construction. See "Official Notices" March 3rd.

Rochdale.—May 16th. The Corporation wants tenders for two 412-KW. steam dynamos. See "Official Notices" April 26th.

Rochdale.—May 23rd. The Corporation wants tenders for copper rail bonds. See "Official Notices" to-day.

Rotherham.—May 17th. The Corporation wants tenders for wiring the municipal buildings. T. H. Copnell, Town Clerk, Town Hall.

South Lancashire.—May 13th. The S. L. Electric Traction and Power Company wants tenders for 6,250 tons of steel tram rails, 190 tons of fish-plates, also points, crossings and filling pieces. See "Official Notices" April 26th.

Spain.—May 15th. Tenders are being invited until the 15th inst. by the Spanish Ministry of Posts and Telegraphs for the establishment and working during a period of 20 years of a telephone exchange in the town of Denia (Alicante province). Particulars may be obtained from, and tenders are to be sent to, La Direccion-General de Correos y Telegrafos, Carretas, 10, Madrid.

Stirling.—Latest date for sending in tenders for steam pipes, &c., has been extended from May 1st to May 10th.

Swansea.—May 15th. The Corporation wants tenders for two-phase motor alternators and switch gear. See "Official Notices" April 26th.

Tonbridge.—May 30th. The U.D.C. wants tenders for Lancashire boilers, two 50-KW. steam dynamos, condensing plant, crane, switchboard, battery, mains, arc and incandescent lighting, house meters, &c. See "Official Notices" April 12th.

CLOSED.

Beckenham.—At a meeting of the U.D.C. on Monday, it was decided to accept the British Insulated Wire Company's tender at £13,693, for the extension of machinery. The boilers and pipework are to be manufactured by Messrs. Babcock and Wilcox, the steam alternator by Messrs. Johnson & Phillips, and the cables by the British Insulated Wire Company. The engineer was authorised to give the order for the work as soon as the necessary contract has been entered into between the Council and the British Insulated Wire Company. The Council also decided to provide a weigh bridge at the electric lighting station, at an estimated cost of £250, the British Insulated Wire Company having agreed to bear two-thirds of the sinking fund and interest, the remaining third to be borne by the Council.

Croydon.—The County Council have accepted the tender of Messrs. H. Windsor & Co., £305, for the construction of engine foundations at the electricity station.

Dee Village.—The Gas and Electric Lighting Committee of Aberdeen Town Council opened tenders in connection with the new electric station and works at Dee Village last week. The tender of Messrs. Babcock & Wilcox, for the supply of six boilers, at £10,175 was accepted.

Halifax.—The following tenders have been accepted by the Corporation: The British Insulated Wire Company, Prescot, 1,548 yards of lead-covered cable, £316; the Electric Construction Company, Ltd., Wolverhampton, sub-station switchboard, £613; Messrs. Johnson & Phillips, Old Charlton, six-conductor telephone cable at £21 per mile.

Hornsey.—The D. C. has accepted the tenders of the following firms, namely:—Fraser & Fraser, Limited, boiler house plant, £4,856; Messrs. Mather & Platt, Limited, engine house plant, £6,601; Messrs. Cole, Marchent & Morley, Limited, condensing apparatus, £1,296; Messrs. Couper, Schwarz & Co., water cooling apparatus, £385; Messrs. Cowans, Limited, switchboard and instruments, £1,585 10s.; Electrical Power Storage Company, accumulators, £2,888 10s.; Messrs. Carrick & Ritchie, overhead travelling crane, £292; Messrs. Siemens Brothers & Co., electricity supply mains, £25,986 5s.; General Electric Company, 1900, Limited, arc lamp pillars and brackets, £3,166 16s. 3d.; the British Thomson-Houston Company, meters, £1,470 15s.; and Easterbrook, Allcard & Co., tools, &c., £324 1s. 2d.

Manchester.—The Edison & Swan Company is to supply a switchboard and all accessories for the Bloom Street generating station.

Stirling.—Messrs. W. Arnott & Co., Coatbridge, have booked the contract for two boilers for the electric lighting scheme.

Tooting Bec Asylum.—At a meeting of the managers of the Metropolitan Asylum District held on Saturday, the Works Committee reported that having advertised for and obtained tenders for (*a*) electric generating plant, and (*b*) boiler plant for heating, &c., at the Tooting Bec Asylum, they recommend that the tender of the Lancashire Dynamo & Motor Company, of Manchester, for the supply and fixing of electric generating plant at the Tooting Bec Asylum, in accordance with the plans and specification prepared by Messrs. Handcock & Dykes, consulting engineers, at the sum of £6,399, be accepted, and that the seal of the Board be affixed to the

contract. The recommendation was adopted. The following is a list of the tenders received:—

Lancashire Dynamo & Motor Company, Limited	£6,399 0 0
Geipel & Lange	6,450 0 0
Crompton & Co., Limited	6 650 0 0
Morley Electrical Engineering Company, Limited	6,760 0 0
Cox-Walkers	6,900 0 0
British Schuckert Electric Company, Limited	7,048 0 0
Brush Electrical Engineering Company, Limited	7,060 0 0
Veritys, Limited	7,110 0 0
Woods, G. H., & Co.	7,424 0 0
Bergtheil & Young	7,597 0 0
Bilbie, Hobson & Co.	7,650 0 0
Suter, F., & Co., Limited	7,757 0 0
Marshall & Woods	7,890 0 0
Dawson, R., & Co., Limited	7,929 0 0
Rosling, Appleby & Fynn, Limited	8,125 0 0
Anderson, T. Scott	8,200 0 0
Calvert & Taylor	8,984 0 0
Nalder Bros., & Thompson, Limited	Informal.

The consulting engineers' revised estimate for the work was £7,292.

Warrington.—The T.C. on Tuesday considered the minutes of the Tramways Committee which contained proposals for the acceptance of the tenders of Mr. J. A. Ewart for the construction of permanent way for the electric cars for the sum of £28,789; also of Messrs. R. W. Blackwell & Co., Limited, for overhead equipment for £4,833 10s., subject to the sanction of the B. of T. to borrow the money. A report was submitted by Messrs. Preece & Cardew on the construction, cost and system of traction of tramways from Sankey Bridges to Knutsford Road, Swing Bridge. Their estimates were: permanent way, £27,000; poles, trolley wires, &c., £6,000; tramcars, £6,340; total, £39,340.

Watford.—Messrs. Ferranti are to supply switch gear (£733), and 12 junction boxes (£210) in connection with the electricity works.

West Ham.—The *Contract Journal* says that the following tenders have been accepted by the T.C.: Hands, Limited, Veritys, Limited, Geipel & Lange, for house wire and wiring accessories; British Thomson-Houston Company, meters; Reason Manufacturing Company, double-pole house cut-out boxes; S. Z. de Ferranti, Limited, transformers; British Insulated Wire Company, cable; Middleton Bros., engine-room stores.

FORTHCOMING EVENTS.

Friday, May 10th.—At 9 p.m. Royal Institution meeting. Paper on "The Response of Inorganic Matter to Mechanical and Electrical Stimulus" by Prof. J. C. Bose.

Society of Arts. Howard Lecture, by A. C. Eborall, on "Polyphase Electric Working." Lecture III.—Polyphase induction motors: standard constructions and features of design—The construction, application, and limitations of the Heyland diagram for polyphase induction motors—Examples taken from practice.

Monday, May 13th.—At 8 p.m. Society of Arts. Cantor Lecture, by Sir W. C. Roberts-Austen, K.C.B., F.R.S., and T. Kirke Rose, D.Sc., on "Alloys." (Lecture IV., to be delivered by Dr. Rose.)

Tuesday, May 14th.—At 7.30 p.m. Institution of Electrical Engineers. Students' Meeting at the Finsbury Technical College, Leonard Street, E.C. Paper on "Rotatory Converter Problems," by F. Vigor.

Wednesday, May 15th.—At 8 p.m. Society of Arts. Nineteenth ordinary meeting. Paper on "Syntonic Wireless Telegraphy," by Guglielmo Marconi.

Friday, May 17th.—Society of Arts. Howard lecture, by A. C. Eborall, "Polyphase Electric Working." Lecture IV.—The polyphase transmission line: overhead and underground work—The effects of capacity and inductance on the working of the system—The fundamental calculations of polyphase transmission systems and installations — The regulation of polyphase systems.

Saturday, May 18th.—At 10 a.m. Institution of Electrical Engineers (Students' Section). Visit to the works of Elliott Bros., Lewisham.

Thursday, May 30th.—The Electrical Standardising, Testing and Training Institution. Prof. C. A. Carus-Wilson M.I.E.E., will commence a series of lectures to the senior students of the above Institution upon "Dynamo and Motor Construction."

NOTES.

Direct Current Electricity Works.—Our yearly table of the direct current electricity works of the United Kingdom accompanies this issue of the ELECTRICAL REVIEW.

Crowded Out.—Owing to extreme pressure upon our space this week, we are compelled to hold over a portion of the week's law and Parliamentary proceedings, also several interesting letters intended for our "Correspondence" columns.

Are You Exhibiting at Glasgow?—You are exhibiting at Glasgow, aren't you? Well, just see that you don't make a mess of it. You have taken a plunge, and it's hardly worth while scoring a failure when success requires so small an effort.

If you've got any enterprise in you, let it be seen now. Don't sit and snooze while your rivals, foreign or otherwise, are wideawake keeping themselves to the fore.

What's on the other man's stand? Don't you know? Well, then, you ought to. If anyone should be interested it's you. When will you again have so good an opportunity of seeing "the latest?" Depend upon it he'll see what you've got.

But there's a right and a wrong time for most things. And there's a wrong time for you to be looking at another's exhibit.

There's a wrong time to be at the buffet with your rival chums.

If your stand is No. Y don't be forever standing with Mr. No. X or Mr. No. Z. A Mr. Somebody-of-more-consequence-to-you may come along and you'll lose a good chance.

If a visitor stops long before your stand don't let him go without a word from you. How do you know that hidden away in the folds of his pocket-book he hasn't got a £10,000 order?

Anyhow, if he stands near your place long, depend upon it it will do you no harm to know that man. Get his card if you can; then your firm can keep on his track afterwards. He may be Pierpont Morgan; or perhaps Carnegie; or perhaps a greater who is well Trusted.

He may be a consulting engineer and can specify your stuff, shutting others out. Consulting engineers are good at that sort of thing. Or perhaps he's a borough engineer who wants electric lighting plant. Or even a tramway official, who wants your rails, or motors, or cars. He may be an electrical manufacturer in search of the best machine tools, and of course ought to see *yours*.

Don't talk too long, you may weary him. But what you *do* say let it be straight to the point; let him know what your things *can* do. That's the very thing he wants to know.

Or even further he may be a Press representative, and of all people in the world you can't afford to shirk *him!*

Representatives of the ELECTRICAL REVIEW have sometimes stood for 5 or 10 minutes before an exhibit at London shows, just to see whether they ever would be spoken to by the men in charge, and have departed with poor opinion of the pushfulness of the exhibitor.

To chat nicely with co-exhibitors may be more amusing than to talk shop with those who have come to see your wares. But it's not the way to make your exhibit pay. Nor will it give your visitors a good opinion of you.

Whatever you do, keep it well before the minds of everybody in the electrical trade that you are to be found at Stand So and So at the Glasgow International Exhibition. Use every honourable means, advertisements or circulars, but keep your name before them somehow!

Light Cure in Hospitals.—Messrs. Drake & Gorham have recently been arranging the supply and fixing of a special motor transformer and other apparatus for use with the "Finsen" lamp at the Manchester and Salford Skin Hospital, which is producing excellent results in the cure of skin diseases. This lamp is similar to the one presented by H.M. the Queen to the London Hospital.

Glasgow.—We are informed that the note under this heading in our last issue was slightly inaccurate, in that the whole of the power required by the tramways recently opened has up to the present been furnished by the 1,000 H.P. direct current sets.

Blast Furnace Gases for Electrical Industries.—In our issue of May 3rd, 1901, we gave a description of an installation at Borbeck, near Essen, where the gases from coke-fed blast furnaces are employed to actuate electric generators by combustion in the cylinders of gas engines, this being the first installation to produce calcium carbide on the Thwaite-Gardner system. The gases are treated by the Thwaite-Gardner patent system before being used in the gas engines, and the installation is the development of a smaller one put down for calcic carbide production by the Blast Furnace Power Syndicate of 150 I.H.P. capacity, described in our issues of December 15th and 22nd, 1899. The plant includes an alternator actuated by an Oechelhauser engine of 1,000 H.P. This electric station is to provide electric current for calcic carbide manufacture, incandescent and arc lighting and motor power for manufacturers. One colliery in the neighbourhood will absorb 1,000 H.P. The gas treatment plant is of 4,000 H.P. capacity, and will be extended to 6,000 H.P. when required. This installation on its completion will be one of the finest in the world, and does credit to the enterprise of modern Germany.

The Consumption of Calcium Carbide.—It is estimated that at the close of 1900 77 villages and hamlets throughout the world were being regularly lighted by means of acetylene, installations in 10 other places being in process of erection. This total is admittedly incomplete, as there are several towns in the United States, the Argentine Republic, and Brazil which are using carbide, but of which no particulars can be obtained. Most of these villages are far too small and poor for an electricity works to have any chance of success; in some the population is only to be counted in hundreds, and the customers for artificial light in tens, occasionally only road lamps having been erected. A few of the others merit the name of towns, and have several thousand inhabitants; but here they are usually located in some situation where there is no water-power worth exploitation, where the price of coal delivered in the village is terribly high, and where, perhaps, a carbide factory is not very far distant. It must be remembered, too, that there is an import duty on petroleum in most Continental countries.

Auction.—Preliminary notice of an auction sale of machine tools at Leeds is published by Messrs. Wheatley Kirk, Price & Co., and appears in this issue.

Faradian Club.—The second annual dinner of the Faradian Club will be held at the St. Ermin's Hotel, Westminster, on Friday, May 17th, at 8 p.m.

Institution of Civil Engineers (Students).—The twenty-sixth annual dinner of the students of the Institution of Civil Engineers was held at the Restaurant Frascati on the 3rd inst. Mr. James Mansergh, F.R.S., president of the Institution, occupied the chair, and amongst the guests were Mr. C. A. Brereton, Prof. Unwin, F.R.S., Messrs. Elliott Cooper, W. Hunter, R. E. Middleton, A. T. Walmisley, Dr. Tudsbery and others. The total number present was 102. The loyal toasts having been given by the chairman and Mr. E. Cooper, Mr. A. C. Kelly, chairman of the Dinner Committee, proposed the toast of "The Institution" in a speech, in which he referred to the excellent effect of the examinations, lately introduced by the Council, on the general training of engineers. The chairman and Prof. Unwin replied, the latter giving an interesting review of the rapid growth of engineering knowledge since the incorporation of the Institution in 1828, and pointing out that although the first Universities were founded for purely technical purposes, their successors have in too many cases degenerated into seats of professedly unpractical learning. Mr. C. A. Brereton proposed the toast of "The Students," to which Mr. Wimperis replied, and a concert of vocal and instrumental music brought a very successful evening to a close.

The Dürr Boiler.—As it has been decided by the Admiralty to try the Dürr boiler in the Navy, a few notes of the marine type of this boiler may be of interest. It consists of a steam drum of rather large diameter, a water leg with a central division plate, and of a large number of double tubes of the Field order, *i.e.*, the outer tube has a free blanked end, and contains an inner tube which supplies water from one of the divisions of the water leg. The tubes are placed at a considerable inclination, but the water chamber is vertical. The upper ends of the tubes are thickened by means of welded-on conical bands, which are pressed into conical holes in the tube plate. These bands are set askew upon the tubes, so that, though the tubes are inclined, the bands are properly normal to the water chamber. The tubes are supported only at their lower ends, and, of course, quite free to expand. The path of the water is down the front chamber of the water leg, down the inner tube, back up the annular space between the two tubes, and up the rear chamber of the water leg into the steam drum. Generally the form and arrangement of the furnace parts is that customary with water-tube boilers of the inclined tube type, that is to say, the products of combustion are delivered from the furnace almost directly between the tubes, so that the probability of smoke is considerable. The whole of the outer casing is of steel plate, and a superheater is provided between the steam drums, when there are two, or round the single one. Its construction, with Field tubes, is similar to that of the boiler.

The Schmidt Patents.—Since the middle of January, when Messrs. Easton & Co., Limited, obtained the license under the Schmidt patents as regards stationary engines, they have secured orders for plants under these patents, all for delivery in the United Kingdom, in excess of 11,000 H.P.

Marriage.—The Glasgow papers announce that on April 30th at St. Columba United Free Church, Helensburgh, Mr. Alfred Ernest Le Rossignol, of Newcastle-on-Tyne, was married to Mary Strathearn, elder daughter of the late Robert Darling, Bonally, Helensburgh.

Horses for Sale.—The Glasgow Corporation having set its electric tramway system in operation, is going to sell its 5,000 horses. A first portion were sold by auction on Tuesday. The animals were knocked down at good prices, bidding being spirited.

Lectures.—Before the Nottingham and District Guild of Engineers, Electricians, and Mechanics last week, a lecture on "Electric Signalling on Railways" was delivered by Mr. William Andrews.

The Newcastle Association of Students of the Institution of Civil Engineers listened to a paper on "Continental Practice in Electric Light Stations," by Mr. G. G. Stoney, vice-president, on 2nd inst.

British Fire Prevention Committee.—Owing to the serious indisposition of Mr. Edwin O. Sachs, chairman of the Committee, the formal opening of the new testing station at Westbourne Park will be postponed to the end of the month, but the first private test is taking place this week under the direction of Mr. Ellis Marsland.

Enclosed Arc Patents.—We understand that the three most important licensees, viz.:—The General Electric Company, Messrs. Crompton & Co., and Messrs. Johnson and Phillips, have each paid a lump sum down for the commutation of royalties under the above patents. The test action against the Davy Construction Company is being pressed on by the Jandus Company, and is expected to come on before long.

A Continuous Carbide Furnace.—In most furnaces of the continuous type, where one electrode is vertical and the other inclined, the process of calcium carbide manufacture is not, strictly speaking, continuous, but occurs somewhat in rushes. This is due to the fact that as a certain quantity of finished carbide flows out of the furnace, its place is taken, more or less suddenly, by a fresh batch of raw material; and however much care is bestowed on warming the mixture before it arrives at the zone of reaction, it is still comparatively cool, and a considerable amount of time is consumed before the reaction between the lime and coke begins again. A German patent has recently been granted which claims to overcome this objection, and to yield a furnace working with absolute continuity. One electrode, as usual, is vertical with its point at the bottom; the other slopes slightly downwards, and its point is roughly level with that of the other. The floor of the furnace also slopes parallel with the inclined electrode; and its dimensions are so arranged that the furnace itself forms a sort of tapering tube, wide at the rear end of the inclined carbon where the lime and coke mixture is fed in, narrow at the points of the carbons where the finished carbide is withdrawn. Thus throughout the whole length of both carbons they are surrounded with lime and coke; a large quantity lying between them at their rear ends, a small quantity only at their points. The current passes between them all along, and as the resistance varies inversely with the amount of mixture present at any given spot, the mass is gradually and steadily raised in temperature as it travels through the furnace, till it arrives between the points of the electrodes, where it is already hot enough to combine at once under the influence of the arc.

The Institution of Electrical Engineers (Glasgow Section).—At the meeting held on April 10th the Council announced their nomination list of office bearers for the ensuing session as follows:—*President:* Prof. Magnus Maclean. *Vice-President:* Henry Mavor. *Ordinary Members of Council:* Messrs. A. R. Bennett, W. A. Chamen, J. D. Cormack, M. B. Field, W. W. Lackie, William M'Whirter, J. M. M. Munro, W. B. Sayers, Thomas Young. As no further nominations were received, these gentlemen were duly elected.

Personal.—At City Road station last week Mr. P. C. Austwick was presented with a chronograph by members of the staff and employés of the County of London Company.

Mr. Edwin Ashton, superintendent engineer of postal telegraphs in the North Wales district, retired from the service on Tuesday of last week. On Saturday evening last, at a smoking concert held in the Alexandra Hotel, Liverpool, Mr. Ashton was presented with a silver centre piece and a gold bracelet and a gold-mounted umbrella for Mrs. Ashton. Mr. D. P. Walsh, acting superintendent engineer of the North Wales district, presided, supported by the Postmaster of Liverpool (Mr. F. Salisbury). The articles presented to Mr. Ashton were subscribed for by the postal telegraph staff at Liverpool.

The Watford U.D.C. has increased the salary of Mr. Colebrooke, chief electrical engineer, to £350 for the current year and £400 for next year.

Mr. J. S. Raworth has been appointed a managing director of the British Electric Traction Company, with the title of "technical director."

Mr. A. S. E. Ackermann, of Victoria Street, S.W., has just left on a visit to the United States, where he will study American engineering methods in general. He has been instructed to report fully on coal-cutting machinery and its applications.

Mr. C. Bullough, late of the engineer's department of the L. & N. W. Railway Company, has been appointed permanent way engineer to the Tramways Committee of the Manchester Corporation.

Appointments Vacant.—Battersea Boro' Council wants an assistant electrical engineer at £175 per annum. The Bedford Corporation wants a shift engineer at £108 per annum.

Calcium Carbide and Phylloxera.—A further report on the value of calcium carbide in destroying phylloxera, based on experiments carried out by Prof. Vassilière, of La Gironde, has been published in the French press. The tests have been proceeding for three years, and have proved most successful, carbide being found cheaper and more efficacious than carbon bisulphide. The carbon employed is either the smalls or waste from the factories, which is practically useless for other purposes, or else a material specially rich in phosphorus compounds, as it appears to be the phosphoretted hydrogen liberated when crude carbide comes in contact with damp soil that kills the phylloxera and mildew of the vines. In treating the vineyards, a quantity of carbide measured in a small vessel is buried in holes in the ground 8 in. deep, and about 4 cwt. altogether are used per acre.

NEW COMPANIES REGISTERED.

May-Oatway Fire Appliances, Limited (69,828).—This company was registered on April 15th, with a capital of £40,000 in 39,850 ordinary shares of £1 each and 3,000 founders' shares of 1s. each, to adopt an agreement with the May-Oatway Syndicate, Limited, C. E. May and G. E. Oatway, and to acquire and turn to account certain inventions, to manufacture and deal in fire alarms, telegraphic apparatus, signals, thermostats, wire, and apparatus of every description which may be required in the application of any inventions in which the company is interested, and to carry on the business of mechanical and electrical engineers, promoters, financiers, &c. The first subscribers (each with 100 ordinary shares) are:—S. B. Heward, 96, Ashley Gardens, S.W., gentleman; H. F. Jackson, 19, New Union Street, E.C., electrical engineer; H. W. Maynard, St. Aubyns, Grosvenor Hill, Wimbledon, gentleman; G. H. Oatway, 5, Montague Place, Russell Square, W.C., hardware merchant; W. Dymock, 12B, Hyde Park Mansions, W., retired bank manager; A. F. Soward, 17—18, Basinghall Street, E.C., shipper; and J. H. Gartside, Overstone Park, Northampton, gentleman. Minimum subscription, one share. The number of directors is not to be less than three nor more than seven; the first are S. B. Heward, H. W. Maynard, W. Dymock, H. F. Jackson, and G. H. Oatway; qualification, £100; remuneration, £850 per annum and a share in the profits, divisible. Registered office, 53, New Broad Street, E.C.

Blackpool Electric Tramways (South), Limited (70,006).—This company was registered on April 29th, with a capital of £250,000 in £10 shares, to adopt a certain agreement (the parties to which are not named), to carry on the construction, maintenance, and working of tramways, light railways, electrical and other motors, and their accessories and appurtenances, to manufacture and deal in all kinds of vehicles, whether propelled by animal or mechanical traction, and all machinery, appliances, apparatus and things capable of being used therewith, to generate and supply electricity for the purposes of light, heat or power, and to acquire and turn to account in connection with the above any patents, real and personal property, buildings, &c. The first subscribers (each with one share) are:—J. C. Benford, 31, Compton Terrace, Highbury, articled clerk; D. J. Norris, 61, London Street, Fitzroy Square, W., solicitor's clerk; H. L. Kohler, Aynho House, Dalston, N.E., clerk; H. F. Braugwin, Spring Villa, Fullers Road, S. Woodford, traveller; G. C. Kohler, 74, Wool Exchange, E.C., merchant; G. H. Smith, Broomers, Wallington, Surrey, manager of public company; and H. Y. Kildersley, 10, Lancing Street, Euston Square, N.W., secretary to public company. If any shares offered to public, minimum subscription £50,000. The number of directors is not to be less than two or more than eight; qualification, £250; remuneration, £200 each per annum (£100 extra for the chairman).

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Notting Hill Electric Lighting Company, Limited (25,921).—This company's annual return was filed on April 3rd, when 8,652 ordinary, 2,298 ordinary preference and 550 founders' shares were taken up out of a nominal capital of £200,000, in 16,452 ordinary, 2,998 ordinary preference, and 550 founders' shares of £10 each. £10 per share has been called up, resulting in the receipt of £122,000. Mortgages and charges, £50,000. Mortgages and charges issued jointly by this company and the Kensington and Knightsbridge Electric Lighting Company Limited, £100,000.

CITY NOTES.

Western Telegraph Company.

The fifty-fifth ordinary general meeting of the shareholders of this company was held on Wednesday at Winchester House, Old Broad Street, Mr. W. S. Andrews presiding.

In proposing the adoption of the report, the Chairman said he was very pleased to meet the shareholders with a greatly improved financial statement. Last May he ventured to put forward the hope that a considerable improvement would take place in the affairs at Brazil, and he was pleased to think that his anticipations had been fulfilled. The policy of conciliation and appeasement of the Government had met with very great success, and the trade and the internal activity of the country generally had greatly increased, and last year's Budget showed a surplus. There could be no doubt that their company had contributed towards that improvement by maintaining a satisfactory international telegraphic communication. As they all knew, telegraphy in these days was a very important factor in commercial life, and there was do doubt that their traffic had helped a great deal towards producing the present satisfactory condition of affairs in Brazil. Turning to the accounts, he said that the total receipts for the half-year, including dividends from their investments in other companies, had amounted to £264,717, as against £230,435 in the corresponding period, which showed an increase of £34,282, and he thought they would all agree this must be considered very satisfactory. The most gratifying feature of the increase was that it practically all arose from increased traffic receipts. The total expenses for the half-year had amounted to £84,139, as compared with £80,579, being an increase of £3,560, and the greater portion of that increase was incurred owing to the South American trouble. The other expenses had increased by £2,533, mainly due to increase in salaries and by the employment of additional members. They had been disappointed in the delivery of their cable steamer *Norseman*, which had recently returned to her station in Brazil after undergoing considerable alterations and repairs. They had also last November had the misfortune to have an interruption in the Lisbon and Madeira No. 1 cable, and had had to engage another ship to endeavour to repair it. The new cables laid last year had enabled them to give a much improved service, and would afford them the means of coping with the considerably increased traffic to which they confidently looked forward. As to wireless telegraphy, he had been asked to say a word or two about that, and all he could say was that he did not think it would ever be a serious competitor with them, but rather it might act as a feeder to them.

Mr. F. Youll seconded the motion, and the report was adopted.

Submarine Cables Trust.

The meeting of this company, held on Tuesday at Winchester House, was presided over by Mr. J. D. Pender, who said that the revenue for the year was £24,901 against £24,789 in the previous year. The income from investments in Anglo-American stock showed a reduction of £144, which was due to the sale of some of the stock, an action which they had proved to be right in doing, because the price is now considerably lower than when they sold. On the other hand, they had received £250 more from the investment in the Commercial Cable Company, though that was simply due to having received during the 12 months five quarters' dividends, whereas the year before they only received three. After meeting the coupons due on October 15th, 1900, and April 15th, 1901, an amount of £3,487 was available for, and had been transferred to, redemption fund. The trustees had disposed of the allotment of the Eastern Extension Company's new shares, which resulted in a net profit of £2,623. Those shares came to the trust in right of holding the old shares, but the trust having no money to invest took the opportunity of selling them, and the result had been the profit mentioned, which with the amount transferred from the revenue account, enabled them to purchase 21 certificates exclusive of the coupons of reversion, and to draw for redemption at £120 per certificate a further 30 certificates.

The report was adopted.

Calcutta Electric Supply Corporation.

Col. A. J. Filgate, R.E., presided on Wednesday at the fourth annual meeting of the shareholders of this company held at the Cannon Street Hotel, and in proposing the adoption of the report, said, in accordance with the powers conferred on the board at the last meeting, they had issued 10,000 new £5 shares at a premium of 10s., which had realised the sum of £5,000, and had been put to the reserve fund. Their capital expenditure for the year had amounted to £37,419, making a total up to the end of last year of £118,266. The license for the Alipore district was officially gazetted on September 12th, and a further licence of additional areas in the vicinity of Sealdah and Calcutta Docks, had been gazetted last April. Part of the new additions to the scope of their operations could be worked, and every endeavour would be made to push on with the Alipore station. In their generating station in Emanhagh Lane they had now two 60-h.p. steam dynamos, two 180-h.p., and two 360-h.p., and they had a third 360-h.p. dynamo, which would shortly be shipped. Plans were now being matured for increasing the accommodation at this station, and they had ordered two 110-h.p. Crompton & Belliss sets to be erected therein, and would increase the power at that station to 3,760 h.p. Four Babcock & Wilcox boilers of 400 h.p. each, had been erected, and further boilers were to be added. An excellent site had been obtained for the new generating Alipore station. The company had already 17 miles of overhead mains and 9 miles of underground mains, and had authorised the laying of about six additional miles of overhead and one mile of underground mains. In order to meet the demand for electrical fans, they had sent out 1,100, and although the manufacture was remunerative, the company did not propose to establish the hiring of fans as a permanent branch of the business. At the end of 1899 the company had on their system 115 houses, and the lamps and motors connected thereto were the equivalent of 9,463 8-c.p., while at the end of last year they had 409 houses, with lamps and motors connected to the equivalent of 28,748 8-c.p.—an increase during the year of 19,285 lamps. The number of units sold were 199,829 for lighting purposes only, and in addition they had sold 213,121 units for power chiefly for electrical buildings, making the total number sold 412,950 for the year, which compared with 54,897 units in the 8½ months in 1899. The gross revenue was £11,147, with an expenditure of £5,742, leaving them with the result for the year's operations of a net profit of £5,395—a result which he thought very satisfactory. Their agents had not at present been able to get any definite proposals for lighting the streets of Calcutta, but reported that there was a strong feeling that most of the important thoroughfares should be lighted by electricity, and they hoped, therefore, they would secure an order at no distant date. The company had practically secured the agreement for lighting the jetties and the Hooghly Bridge, and hoped to receive the contract as soon as their mains were laid in Harrison Road.

Mr. E. Boulnois, M.P., seconded the motion, and the report was unanimously adopted.

Cuba Submarine Telegraph Company.

The fifty-ninth ordinary general meeting of the shareholders of this company was held on Wednesday at 58, Old Broad Street, E.C., Mr. C. W. Parish presiding.

In moving the adoption of the report, the Chairman said he regretted to say that the revenue account of the company was not of such an excellent character as they had been accustomed to. It was disappointing to see that their traffic receipts showed a serious falling off, due, he had no doubt, to competion of new routes and reduction of rates, and this state of things naturally upset the unique position occupied by the company for many years. Respecting the Spanish-American war, he thought nothing could have been done by them to have altered the progress in connection with the war in the Island of Cuba. Both America and Cuba were negotiating as to the future government of the island, and it therefore fell to the company to watch carefully as to how their interests would be best served amid the changes going on around them. Turning to the report, the revenue account ending December 31st last showed that they had earned by traffic £8,904. Interest on investments was £2,059 and transfer fees £7, giving a total of £10,970 as compared with £14,195 in the previous half-year, showing a falling off of £3,225. Their expenses for the half-year ending December, 1900, were £5,502, and in the same period of 1899 they were £6,192, a saving of £690, which was satisfactory, and reduced the net falling off of income to £2,535. A great deal of the saving in their working expenses had been made in the items of expenses at stations, but he was afraid there was no more elasticity to work upon. Their staff, both here and in Cuba, thoroughly knew the position of the company, and would do all they could to meet the harder times which perhaps were in store for the company. Last July they carried forward a balance of £5,204, and adding this to their profits for the past half-year, it gave them a total of £16,175, out of which it was proposed to pay a dividend of 4 per cent. per annum on the ordinary shares, after the payment of £3,000 to the preference shareholders. The shareholders would regret to learn that the company had not yet received their claim of £8,174 against the Government of the United States for damage done to their cables during the Spanish-American war.

Mr. George Keith seconded the motion, which, after some discussion, was adopted.

West Coast of America Telegraph Company.

The meeting of this company held at Winchester House on Tuesday, was presided over by Mr. J. D. Pender, who, in moving the adoption of the report, referred to the figures therein, and mentioned that the expenses and receipts showed increases which were largely due to the value of the exchange which during 1900 varied from 15¾ to 17; in 1899 it varied from 12¼ to 16. The expenses included the cost of six repairs to cables. The most important was the Molinda cable, the breaking of which was due to chemical action. Another break was due to landslip caused by a ship grounding, and the Antifogasta cable broke on account of the rocky bottom, and they had to cement the cables in so that they would not wash about and get chafed through. Last year the high cost of coal increased the cost of working their cable repair steamer beyond what it would have been in an ordinary year. It was altogether satisfactory that they had increased receipts on those of 1899 and 1898. Of the balance of £8,197, they proposed to pay £6,000 in debenture interest, £800 on income bonds, and to devote £709 to wiping off

the balance of the reconstruction expenses (an item which would not now appear in the accounts again), and £583 would be carried forward. That was nearly double the amount carried forward last year. In regard to the year 1901, so far they had had no interruptions, although they had got through nearly five months of the year. The traffic receipts were maintained, and in last year's accounts it was shown that they had sent out cable to the value of £4,000, which placed them in the position of having an efficient stock of cable, such as they had not had before, ready for any emergency.

Sir A. Leppoc Cappel seconded the adoption of the report, which was carried unanimously, and a vote of thanks closed the meeting.

Great Northern Telegraph Company of Copenhagen.

The general meeting of this company was held at Copenhagen on April 30th, Mr. F. Zahle presiding. An account of the working of the company and its various cables during 1900 was given by the chairman and managing director, Commodore E. Suenson. The report and balance-sheet were adopted and retiring officials re-elected. The interim dividend was 5 per cent., and the final dividend 10 per cent, making a total of 15 per cent.

Stock Exchange Notices.—The Stock Exchange Committee has ordered the undermentioned securities to be quoted in the Official List:—Dorman, Long & Co., Limited—£400,000 4 per cent. perpetual first mortgage debenture stock, in lieu of the provisional certificates now quoted; Edison & Swan United Electric Light Company, Limited—£100,000 5 per cent. second debenture stock, in lieu of the provisional certificates now quoted.

Bordeaux Electric Tramways and Omnibus Co.—The directors have declared a dividend of 7.50f for the year ended December 31st, 1900, payable on 15th inst., at the rate per share of 7.20f on registered shares by endorsement on certificate, 7.55f on bearer shares numbered 1 to 50,500, and 6·56f on bearer shares numbered 50,501 to 100,000.

Primitiva Gas and Electric Lighting of Buenos Ayres.—Messrs. James Capel & Co., of 31, Throgmorton Street, E.C., offer for subscription until this afternoon at 97½ per cent. £400,000 of 4 per cent. first debentures in the Primitiva Gas and Electric Lighting Company of Buenos Ayres, Limited.

British Westinghouse Company.—The transfer books will be closed until May 15th, inclusive, for the preparation of the interim dividend warrants for six months to January 31st last.

London Platino Telegraph Company.—A meeting of this company was held at the offices, Winchester House, E.C., on Tuesday, but the proceedings were conducted in private.

Thames Iron Works and Shipbuilding Co.—The subscription list of the 5 per cent. registered second mortgage debentures was to close yesterday.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending May 4th were £490; corresponding week last year, £423; increase, £67. Total to date, £7,781; corresponding period last year, £7,002; increase, £709.

Blackpool and Fleetwood Tramways.—The receipts for the week ending May 4th were £360; corresponding week last year, £333; increase, £27. Total to date, £3,950; corresponding period last year, £4,252; decrease, £302.

Bristol Tramways and Carriage Company.—The receipts for the week ending May 3rd were £4,494; corresponding period last year, £2,881; increase, £1,613.

Central London Railway.—The receipts for the week ending May 4th, were £6,428; previous week, £6,611; decrease, £183. Total receipts to date (18 weeks), £111,023. Miles open, 6.

City and South London Railway.—The receipts for the week ending May 5th were £1,855; corresponding week last year, £1,283; increase (Moorgate extension open) £572. Total to date, £35,716; corresponding period last year, £22,246; increase, £13,470. Miles open, 1901, 4½; 1900, 3½.

Dover Corporation Tramways.—The receipts for the week ending May 27th were £199 7s. 10d.; corresponding week last year, £189 5s. 10d.; increase, £10 2s. 0d. Total to date, £3,070 13s. 3½d.; corresponding period last year, £2,842 19s. 3½d.; increase, £227 14s. 0d. Miles of track open, 3; Car miles run, 1901, 5,071; 1900, 4,931. Number of cars, 1901, 11; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending May 3rd were as follows:—D. U. T. Co., electric cars, £3,645 12s. 3d.; D. S. D. Co., electric cars, £851 6s. 9d.; total £4,499 19s. 0d.; corresponding week last year—D. U. T. Co., electric cars, £3,421 12s. 0d.; ditto, horse cars, £55 9s. 4d.; D. S. D. Co., electric cars, £804 7s. 7d.; total, £4,281 8s. 11d.; increase, £218 10s. 1d.; aggregate to date, £69,546 5s. 7d.; aggregate to date last year, £71,322 8s. 2d.; decrease, £1,776 2s. 7d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and 2 miles by horses, for the corresponding period last year.

Glasgow Corporation Tramways.—Receipts for week ending April 27th, 1901, £10,112 16s. 11d., as compared with £8,960 11s. 6d. for same period last year.

Liverpool Overhead Railway.—The receipts for the week ending May 5th were £1,632; corresponding week last year, £1,433; increase, £199. Total to date, £27,551; corresponding period last year, £25,336; increase, £2,215. Miles open, 6 miles 57 chains.

St. Helens Tramways.—For the week ending May 1st, 1901, 26,677 more passengers were carried by cars of the St. Helens and District Tramways Company, and £171 11s. 9½d. more money was received than in the corresponding week last year.

STOCKS AND SHARES.

Wednesday Evening.

The proverbial tedium of a nineteen-day account has hardly lived up to its reputation during that which is now drawing to a close. The current week, for instance, is seeing a very fair amount of general business in high-class markets, notwithstanding the weakness of Consols, and the disappointing nature of the Board of Trade returns for foreign commerce during April. More particularly in the Telegraph market (amongst those departments sacred to electrical enterprise) has the buyer predominated, and the cheery effect of his presence is visible in half a score of advanced prices. The Supply division also exhibits a stronger appearance, although the recordable changes are few and far between. Nevertheless they are in the upward direction. Electric Railway securities are also good, and there has been quite a run on National Telephone issues. Manufacturing shares display a somewhat irregular tendency.

The Home Railway market, as a whole, is moving with extreme caution in view of a possible strike all over the country. But City and South London stock has not only resisted the heavy tone which affected the rest of the list, it has even added another 1½ per cent. to its price, making a 5 per cent. rise in a fortnight. The ostensible reason for the appreciation is that to which we referred last week, viz., that the cricket season should stimulate the line's traffics. But we have seen so little real buying of the stock in the market that some wonder is aroused as to the real reason for the marking up of the the price. In other words, the rise looks more like a market movement than an expansion caused by actual demand for stock.

Central Londons retain their small advance of last week. The market are buyers at 9½, despite rumours of another capital issue. Metropolitan District stock is up to 30, and the revised rates for season tickets are being vigorously circulated. Metropolitan Consolidated stands at 79½; the lowest price it touched this year was 71½, and the highest in 1901 so far has been 85.

In the electricity supply market, both Metropolitans and Westminsters have added 10s. to their quotations. Besides the temporary withdrawal of the Marylebone Council's Bill, the buyers of Metropolitan apparently have another card in their hand. It is being quietly stated that the Marylebone Council has decided to take over the company's undertaking in the Council's district, and at a price to be fixed by arbitration. Whether this be true or not, this rumour is pretty generally credited in Capel Court, and Metropolitans, down to 10½ less than three weeks ago, are now 12½. The shares of the new issue are 10s. cheaper. Westminsters are in good demand: the old and new shares rank in all respects together, and the price has risen to 13 middle. London Electric Preference are being sold slightly after their recent spurt, but on the whole the market is a good one.

The mad boom in Yankee rails has blown good to the holders of Anglo-American telegraph investments. The trio of stocks belonging to the Anglo Company has advanced generally, and Anglo "A" is nearly 3 per cent. above the last making-up price. Directs are also better, but there is no change in Commercial Cable stock. Submarines are 1 up. The Direct West Indian Company's Debentures are a point harder; Cubans are about the same as they were last week. We hear incidentally that the electrification of Cuba's tramway system is rapidly finishing, and that excellent results are already being attained.

In the Eastern group there is a better feeling throughout the market. Eastern Ordinary is 2 per cent. to the good. The 4 per cent. Debentures (Mauritius) of the Eastern and South African Telegraph Company are two points down, the price having been lowered in order to bring it into line with the company's other 4 per cent. Debentures.

Telephone shares have had a somewhat remarkable spring to the front, and this week has witnessed strong buying, especially of Nationals. The Ordinary and the Third Preference have been most in favour, and we welcome the narrowing of the official quotation, inasmuch as it means, paradoxically, a widening of the market in the shares. Chili telephones are also spurting, while Orientals are becoming much more marketable.

As regards new issues, the British Insulated Wire Debenture scored a distinct success, and the price remains steady at 2 premium. The new Charing Cross Debentures are about the same price. An offer of £100,000 second 5 per cent. Debentures at 97½ by the Thames Ironworks, Shipbuilding and Engineering Company has been received with mixed criticism. While on this question, may we not press for a special settlement in the latest issued British Electric Traction Preference? It is high time that this should be obtained. The electric tramway market is quiet, with little business passing. Manufacturing shares show a decline here and there, but the fall is very slight, and is mainly due to the plethora of gilt-edged stocks now on offer in other sections of the Stock Exchange.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation May 1st.	Closing Quotations May 8th.	Business done during week ended May 8th, 1901. Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —102	99 —102	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	55 — 65	55 — 65	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3¼%	53 — 56	55 — 58	56	55
3,088,540£	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	97 — 99	98 —100	99⅝	98½
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	10¾— 11¼	11 — 11½	11 7/16	10½
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	...	3¼— 3⅜	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	100 —102	101½	100¼
16,000	Cuba Telegraph	10	8 %	7 %	...	7½— 8½	7½— 8½	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	16 — 17	16 — 17	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	100 —104%	100 — 104%	...	...
60,710£	Direct United States Cable	20	3½%	3 %	3 %	9⅜— 10¼	10 — 10½	10⅜	10
108,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	135 —140	137 —142	140	135
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	91 — 94	91 — 94	93½	92
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	111 —115xd	110 —114	113½	111
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13½— 14	13½— 14	13 1/16	13½
50,000	Do. Nos. 250,001 to 300,000 (iss. at £3 pm. all pd.) ...	10	...	...	...	13½— 14xd	13½— 14	...	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	111 —116	111 —116	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	101 —104%	99 —102 xd	...	...
180,227	Globe Telegraph and Trust	10	5⅛%	5¼%	...	9⅜— 10¼	9⅜— 10¼xd	10⅛	9 1/16
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14¾— 15¼	14¾— 15¼xd	15	14¾
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	34 — 36	34 — 35	33¾	...
82,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	44 — 48	45 — 49	47½	46½
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼— ½	¼— ½	3/8	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	½— 1	½— 1	½	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	2¾— 3¼	3¼— 3½	3⅜	2⅞
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10 — 12	10 — 12	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	10 — 12	10 — 12	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	3¾— 4¼	4 — 4¼	4⅛	4 1/16
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	87 — 90	87 — 90	88	86
500,000£	Do. 4 % Deb. Stock Red.	100	...	...	4 %	95 — 98	95 — 98	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	⅞— 1⅛	15/16— 1 1/16	15/16	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	...	7½— 8½	7½— 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	120 —125	121 —126	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	4½— 5	4½— 5	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅝— 5¼	4⅝— 5¼	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	97 —100	97 —100	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— ⅝	½— ⅝	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	99 —102	100 —103	100½	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13¾—14½	13¾— 14½	14⅛	13¾
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	101 —104	101 —104	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	102 —105	...	...
88,321	West India and Panama Telegraph	10	2 %	8⅝%	...	⅝— ⅞	⅝— ⅞	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	6 — 7	6 — 7	6¾	6¼
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	5 — 7	5 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	103 —106	103 —106	105	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7¾— 8¼	7¾— 8¼	7⅞	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8½— 9	8½— 9	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	9⅛	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5 — 5½	5 — 5½	5⅜	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5⅜— 6¼	5⅜— 6¼	...	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8½— 9½	8½— 9½	9⅛	8⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12 — 13	12 — 13	12⅛	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	124	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8 — 9 xd	8 — 9	8½	8⅜
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	11 — 12 xd	11 — 12	...	...
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	106 —109	106 —109	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	7 %	...	...	5 — 5½	5 — 5½	5⅜	5¼
13,363	Do. do. 6 % Cum. Pref.	...	...	...	...	5½— 6	5½— 6	...	...
75,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	103 —106	103 —106	105⅝	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	102 —105	102 — 105	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	4⅝	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —101	98 —101	...	..
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	11½— 12½	12 — 13	12⅞	12⅝
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	110 —113	110 —113	112⅜	111
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	96 — 99	...	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½— 16½	15½— 16½	16	15⅞
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14 — 15	14⅜	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	9¼	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2¼— 3¼	3 3/16	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½%	12 — 13	12½— 13½	13	12¾

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked † are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation May 1st.	Closing Quotation May 8th.	Business done week ended May 8th, 1901. Highest	Lowest
20,000	British Aluminium 7 % Cum. Pref.	‡ 10	...	...	...	7½ — 8½	7½ — 8½	...	...
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	89 — 93 xd	85 — 93	...	...
45,000	British Electric Traction	10	6 %	...	...	15 — 16	15 — 16	15½	15⅛
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	...	...
350,000£	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	119 —122	119 —122	121	120⅜
85,000£	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	1/16 — 3/16	1/16 — 3/16	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	3/16 — 5/16	3/16 — 5/16	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	85 — 90	85 — 90	...	...
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	10 — 11	10 — 11	10½	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1⅝ — 1⅞xd	1⅝ — 1⅞	1 1/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2 — 2⅛xd	2 — 2⅛	2¼	2 3/16
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710£	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	101 —103	101 —103	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	14½ — 15½	14½ — 15½	14⅞	14¼
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	5⅝	5½
90,000£	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	9¼ — 9⅜	9¼ — 9⅝	9 1/16	9⅛
78,703	Do. do. Pref. half-shares	5	...	...	...	4⅜ — 5⅛	4⅜ — 5⅛	4⅞	4 1/16
78,703	Do. do. Def. do.	5	...	...	...	4½ — 5	4½ — 5	4⅞	...
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1¼%	50 — 53	51 — 53	53	51
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5 — 5½	5 — 5½	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	...	3½ — 4	3½ — 4	...	...
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	101 —104	101 —104	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	1½ — 2	1½ — 1⅝	1 1/16	1½
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	...	3 — 4	3 — 4	...	...
344,023£	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	87 — 89	87 — 89	...	...
100,000£	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	94 — 98	94 — 98	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅝ — 2¼	1⅝ — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2¾ — 3¼	2¾ — 3¼	2 1/16	2⅞
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	101 —104	101 —104	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	15 — 16	15½ — 16½	15 1/16	15½
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½ — 6	5½ — 6	...	...
50,000£	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	107 —111	107 —111	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	‡ 10	10 %	10 %	...	21 — 22	20½ — 21½	21⅜	21
300,000£	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3½%	7 1/16 — 8 1/16	7 1/16 — 8 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13½	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	36 — 40	36 — 40	36	...
150,000£	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	101 —104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	...	10⅛ — 11⅛	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	94 — 97	94 — 97	94½	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 3/—4/-
National Electric Free Wiring, 12/6 paid, 7/16—1/4.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16—17.
Do. do. Pref. (£10 pd.), 10—11.
*T. Parker, £10 (fully paid), 16½.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (February 21st, 1901).

MARKET QUOTATIONS, Wednesday, May 8th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3½d.	3½d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	61/-	64/-	3s dec.
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5s.	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£8	£8	..
,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £130	£75 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	7½d.	7½d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8½d.	8½d.	..
c ,, Wire, basis	per lb.	8d.	8d.	..
c Copper Tubes (brazed) ..	per lb.	11d.	11d.	..
c ,, ,, (solid drawn) ..	per lb.	10½d.	10½d.	..
g Copper Bars (best selected) ..	per ton	£85	£85	..

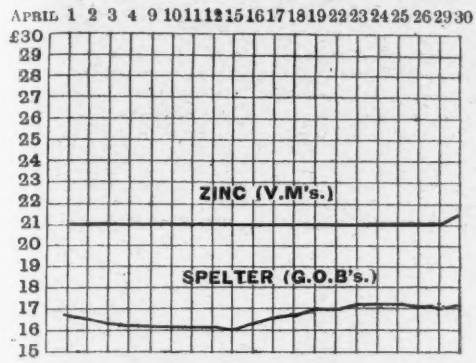
METALS, &c. (*continued.*)		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£85	..
g ,, Rod	per ton	£85	£85	..
e ,, (Electrolytic) Bars ..	per ton	£82	£82	..
,, ,, Sheets ..	per ton	£90	£90	..
e ,, ,, Rod ..	per ton	£84	£84	..
e ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/8 to 3/8½	3/9½ to 3/10	dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	46/8	45/6	9d. inc.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£10 5	£10 5	..
g Lead, English Ingot	per ton	£12 5 to £12 11 3	£12 5 to £12 11 3	..
g ,, ,, Sheet	per ton	£15	£15	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£121 to £122	£121 to £122	..
g ,, foil	per lb.	1/9	1/9	..
n ,, wire, Nos. 1 to 16	per lb.	1/8	1/8	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	8¼d.	8½d.	½d. dec.
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 5	£14 5	..
k Zinc, Sh's. (Vieille Montagne ond.)	per ton	£21 10	£21 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

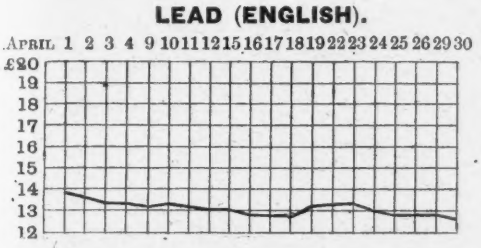
Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Jackson & Till. i Messrs. Bolling & Lowe. j Messrs. Henry C. Yso & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

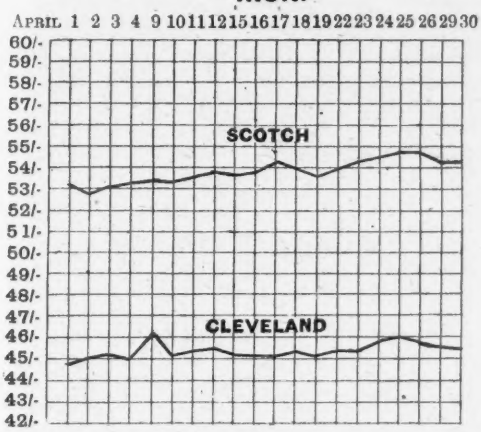
METAL MARKET.—Fluctuations in April.



LEAD (ENGLISH).



IRON.



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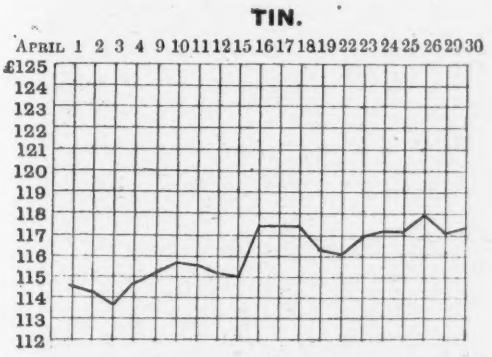
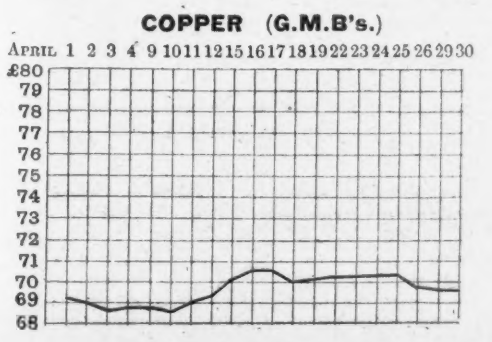


COPPER (G.M.B's.)



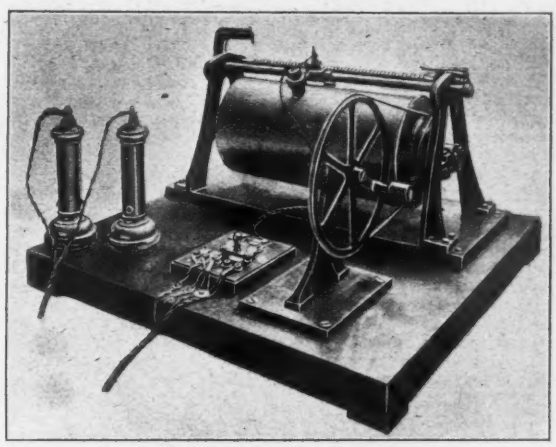
IMPORTANT EUROPEAN ELECTRICAL AND ENGINEERING DEVELOPMENTS.*

By WILLIAM J. HAMMER.

[Note.—The author's description of the "telegraphone," as reproduced below, is so interesting and complete, that we have thought it unnecessary to prepare an article on this instrument, which is now on exhibition in London. We have, however, substituted our own photographs for those reproduced in Mr. Hammer's paper. We may add that a full account of the apparatus was published in our issues of April 27th and October 12th, 1900.—Eds. Elec. Rev.]

The Telephonograph.

The telephonograph, or, as it is sometimes called, the "telegraphone," is the invention of a Danish electrical engineer, Mr. Waldemar Poulsen. This beautiful and ingenious instrument was considered by all those who had the opportunity of seeing and testing it at the recent Paris Exposition to be the most interesting scientific novelty there exhibited. The apparatus, which is indicated in fig. 1, consists of a drum of brass about 11½ in. in length by 5½ in.



[Photograph by the Electrical Review.]

Fig. 1.

Steel Wire "Telephonograph."

in diameter. On this drum, which is revolved by hand or by an electric motor, is wound 225 turns of steel piano wire, of a diameter of about 1 mm. Supported above this wire, but not in contact therewith, is a tiny magnet, such as are shown in fig. 2, letters A and C, which are almost natural size. This magnet is attached to a brass support, mounted on a shaft, so that as the drum or cylinder carrying the steel wire revolves, the magnet is caused to move from right to left across the drum, being guided by a grooved finger resting upon the steel wire on the drum, each turn in the steel wire passing consecutively before the poles of the tiny magnet. On reaching the end of the cylinder an arm mounted on the left side of the frame strikes the tiny lever shown in the illustration, raising the magnet and causing it to run rapidly back to the beginning again (the carrier being guided by the coarse threaded shaft shown parallel to the supporting shaft), this operation taking about five seconds. The legs of this magnet are about $\frac{7}{16}$ in. long, and are wound with bobbins of wire of about the same size as those employed on an ordinary receiving telephone magnet. A cross-section of the magnet is shown in fig. 2, letter C. It has been found that a horse-shoe form of magnet, as shown in fig. 2, letter B, will not respond rapidly enough, and it is

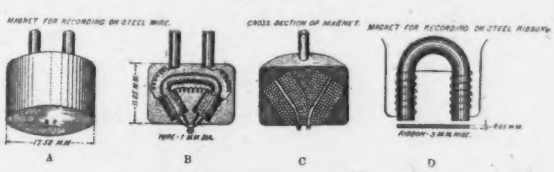
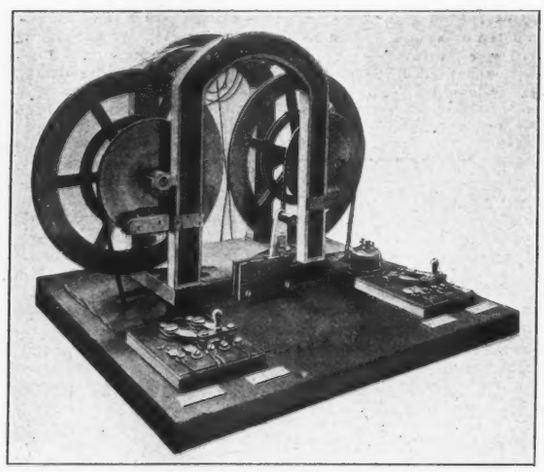


Fig. 2.—Telephonograph Magnets.

preferable to employ two separate magnets electrically connected, as shown in fig. 2, letter C. In the ribbon form of telephonograph the horse-shoe magnet shown in fig. 2, letter D, may be used, but even here two magnets electrically connected are preferable. This recording electro-magnet, which has a resistance of 100 ohms, is connected in circuit with an ordinary carbon telephone transmitter, and a couple of cells

* Abstract of paper read by Mr. W. J. Hammer before the American Institute of Electrical Engineers, February 28th, 1901.

of battery, and preferably with an induction coil in the usual manner. When the transmitter is spoken into, it acts as a tap upon the battery, and causes currents of varying strength, in proportion to the strength of the sound waves impinging upon the diaphragm, to pass through the wire wound on the electro-magnet. Now, as the steel wire wound on the drum passes in front of, but not in contact with, the poles of the magnet, its varying magnetic field magnetises transversely the steel wire, and is permanently recorded therein. After the steel spiral has been filled, which operation takes about 39 seconds at an ordinary speed of talking, and records 100 to 120 words, the tiny magnet is placed at the point where the record first started, and in place of the transmitting telephone with which it was connected, a Bell receiving telephone is attached. The cylinder, or drum, again revolves, and as the magnetised steel wire passes before the poles of the electro-magnet, it forms a species of magneto-electric generator, giving out currents of electricity of a strength and direction corresponding to the magnetisation of the steel wire, which correspondingly affect the Bell telephone, and reproduce the sounds and words originally spoken with absolute fidelity. In Edison's phonograph and its modifications, such as the graphophone, gramophone, &c., a stylus is always employed to indent the surface of wax, metal, or other yielding substance. The stylus, resting upon such a surface, and being attached as it is to the vibrating diaphragm of the phonograph transmitter, is affected by the dampening effect of the needle or its inertia, and the higher harmonics are more or less destroyed, and there are also false sounds produced, due to the molecular disturbances in the needle and diaphragm itself. Although Mr. Edison has recently made remarkable improvements in the perfection of recording and reproducing by means of his phonograph over his earlier forms, there are difficulties, such as I have referred to, which it has heretofore been impossible to overcome. In Poulsen's telephonograph, however, the tiny magnet not being in contact with the steel wire, the lines of force are silently stored up, and without being affected by external influences. The author has had considerable experience in working with various types of phonographs, and was accorded facilities to examine and operate the telephonograph, both at Paris and at Berlin, and still more recently here in New York. In Berlin, Messrs. Mix & Genest have for some time past been conducting a laboratory for experimental development of the telephonograph, and through their courtesy, and that of Director Zopke, I was afforded the pleasure of visiting this laboratory, and saw some very interesting developments in this promising field. I found the instrument would record and reproduce the most delicate sounds, even breathing and very low whispering, and certain words which those who have had experience in working with the phonograph know have always been very difficult to record and reproduce perfectly. All have been taken care of most perfectly by the telephonograph. If it is not desired to retain the record made upon the steel wire, the recording magnet is placed at the end of the drum, and connected with a couple of cells of battery, which supply a constant magnetising current to the magnet, which entirely obliterates the records which had been stored up in the steel wire, as this wire is passed before the poles of the magnet. A permanent magnet may also be employed for this purpose.



[Photograph by the ELECTRICAL REVIEW.]

FIG. 3.—STEEL RIBBON "TELEPHONOGRAPH."

Another type of instrument which Mr. Poulsen has designed, is shown in fig. 3. This consists of two reels, carrying a band or ribbon of steel about $\frac{3}{16}$ in. wide and about $\frac{1}{64}$ in. thick. This steel ribbon, which may be made of any length, and which may be recorded upon for an hour or more at a time, is passed from one reel to the other—the reels being operated by a small electric motor. Above the steel band or ribbon is placed a tiny electro-magnet of the form shown in fig. 2, letter D, which is connected to a telephone transmitter and battery, in the same manner as in the instrument already described, and after a record has been made, is also connected to a Bell telephone, as a reproducing instrument. It is stated that these steel ribbons after receiving the magnetic record could be wound in many layers, similar to a spool or bobbin of ribbon, without affecting the record, and that the record could be reproduced thousands of times. It is said that a record has been reproduced 2,200 times and has still been very perfect, and such a spool containing a record could be shipped across the country and placed on another machine, and would reproduce the sounds which originally caused the record, with absolute perfection; even a rusty wire containing a record has been sand-papered and polished, without affecting appreciably the record. In fig. 5, letter D, is indicated: first, how the steel band is magnetised by the obliterating magnet, then by the varying field of the recording magnet, and, finally, the reversal in direction. The Poulsen telephonograph in

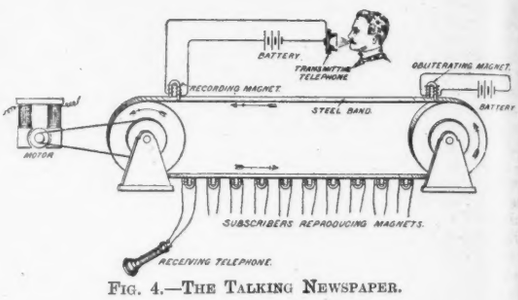


FIG. 4.—THE TALKING NEWSPAPER.

its ordinary form does not speak louder than an ordinary Bell telephone. I would suggest the employment of Edison's "electromotograph" or "chalk" telephone receiver, by means of which it could be made to speak very loud. (An audience of 5,000 has been able to hear perfectly this Edison's loud speaking telephone.) Mr. Poulsen has suggested a number of other methods by which the sound be augmented. It is claimed that by increasing the speed during reproduction over that of the recording speed, the telephone speaks much louder. This would, however, tend only to increase the pitch, and not improve the volume of the sound. Other methods suggested by Mr. Poulsen are indicated in fig. 5, letters A and C. They consist in substance of methods for causing

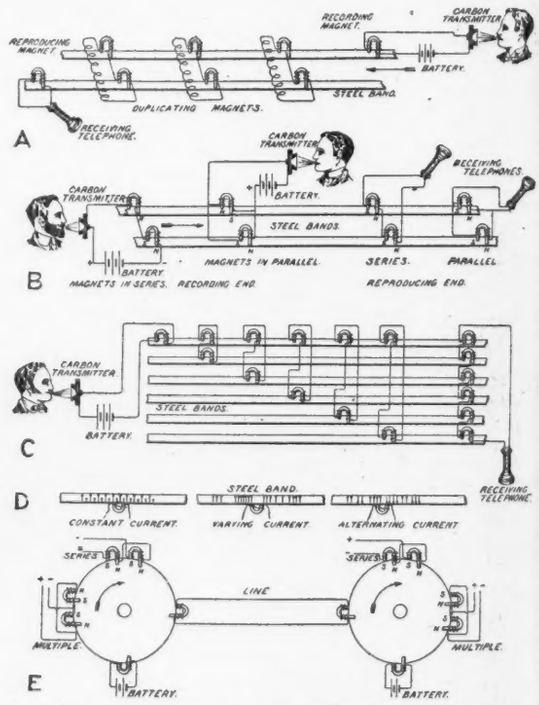


FIG. 5.—PROPOSED METHODS FOR INCREASING VOLUME OF SOUND AND FOR DUPLEXING.

one transmitter to make a number of records on separate steel wires or bands which, on repeating, cause the various reproducing magnets to simultaneously affect the one telephonic receiver. It has also been proposed to utilise the telephonograph as a talking newspaper. In fig. 4 is shown a method which it is proposed to employ. As the steel ribbon, which in this particular form is endless, and which is receiving the record, passes from one reel to the other, as indicated by the arrows, it passes consecutively before each of the receiving magnets, which are shown in horse-shoe form, but

which may also be single pole, and the subscribers, whose telephones are attached to these magnets, are thus constantly being supplied with the latest news of the day, stock quotations, &c. After the ribbon or band has passed before these magnets, the obliterating magnet wipes out all of the magnetic lines of force stored up in the steel band, and it then passes on to receive fresh impressions from the recording magnet and telephone. It remains to be seen how important the practical applications of this wonderful scientific instrument will become, but it is self-evident that any invention possessing such intrinsic merit, is certain sooner or later to meet with important commercial applications. The author in common with many others has used the phonograph in his office; dictating at his convenience his correspondence upon the cylinders, from which it was later transcribed by the typewriter. He was recently shown and operated a form of Poulsen's telephonograph, which had three magnets attached to the recording magnet carrier, which enabled him to start, stop, and reverse the movement of the carrier, and also obliterate errors in the wire. In fig. 5, letters B and E, are shown two methods proposed for duplexing. The two sets of magnets are shown connected, in the one case, in parallel; and in the other, in series. These magnets may all be connected in series, or all in multiple, but it is essential that they should have the proper polar relation. It is claimed that these two sets of recording magnets send waves of a different character over the line, and at the receiving end of the circuit, each reproducing magnet will respond to its proper wave. I believe the form shown in fig. 5, letter E, has never been demonstrated to be practicable, but the one employing the two ribbons shown in fig. 5, letter B, has been operated successfully. Suggestions have been made for using the telephonograph as a telephonic relay, and I am informed that some experiments have been made recently in this direction, in Europe; it may perhaps not be out of place in this connection, to call attention to the experiments made by the author in employing the phonograph as a telephonic relay, at the time of his lecture on "Edison and his Inventions," delivered before the Franklin Institute on February 4th, 1889. For this purpose the author used an arrangement of two phonographs, four telephones, two sets of induction coils and batteries and other apparatus, circuits, &c. These experiments constitute, I believe, the first practical form of telephonic relay which has ever been constructed, and which operated with perfect success over 104 miles on the lines of the Long-Distance Telephone Company, between New York and Philadelphia. (It is interesting to note that the sound passed through the air five times, through 15 separate mediums, and changed its physical characteristics 48 times in transmission.)

(To be continued.)

INSTITUTION OF ELECTRICAL ENGINEERS.

ON TEST-ROOM METHODS OF ALTERNATE CURRENT MEASUREMENT.

By Albert Campbell, B.A.

(Paper read April 18th, 1901.)

The object of this paper is to describe a number of methods of measurement, some of which are capable of fairly general application, while others are only of use in special cases. Many of these methods are novel, I believe, and most of the others are not well known. Owing to the nature of the subject, it is not possible to connect the whole into a coherent sequence, but for convenience of reference, I have numbered the methods consecutively.

Section A.—*Transformer Methods of Measuring Current, Voltage, and Power.*—In the test-room there is no special difficulty in measuring either currents or voltages of ordinary magnitudes; with continuous currents the use of moving-coil instruments renders the measurement of very large or very small values easy and accurate. With alternating currents, however, the measurement of the extreme values is not so easy, and it is for this purpose that transformer methods are specially valuable. Fig. 1 shows two typical methods. In the first method (which is fairly well known) C, the whole current to be measured, goes through the primary coil of a transformer, the secondary of which is connected to an ammeter, A. In Method 2 the current passes through a low non-inductive resistance, r_1, giving a small voltage drop, v_1, which is transformed up so as to give readings on the electrostatic voltmeter E. As to Method 1, some years ago I investigated * the conditions by which the ratio of current transformation can be kept sufficiently constant and independent of frequency. I found that it was necessary to have:—

(*a*) An air-core transformer, or one with a well closed iron circuit.

(*b*) Relatively low resistance and high inductance in the secondary circuit.

Method 2.—It is to Method 2, however, that I wish to draw special attention at present. Here the measuring instrument, being electrostatic, is unaffected by variations in frequency, and if of good type, has a very high degree of accuracy. [If a reflecting electrostatic voltmeter be set up in a fixed position, and a scale for it (say, at 2 metres distance) be drawn by calibration with a potentiometer and direct current, an accuracy of at least 2 in 1,000 is attainable over a large part of the range. In most of the measurements in this part of the paper I have used such a voltmeter.] For currents from 5 amperes and upwards the resistance, r_1, should be so small that not more than 0·5, or at most 1 volt, is lost in it. If the voltmeter reads to about 120 volts, this necessitates a high transformation ratio, at least 1 : 100, in the transformer. To keep the voltmeter readings proportional to the current, I find it best to use a transformer with

(*a*) A well closed iron circuit.

(*b*) A highly inductive primary coil of very low resistance (*i.e.*, large time constant).

It is difficult to thoroughly carry out condition (*b*) without employing a considerable weight of either iron or copper, but very fair accuracy may be attained with a quite small transformer, as the

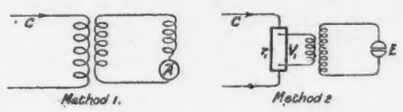


Fig. 1.

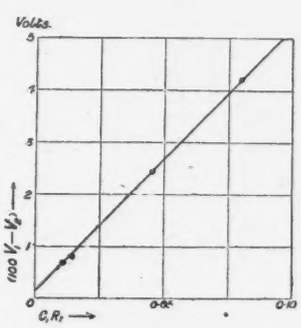


Fig. 2.

following instance will show. The core consisted of annular iron stampings of total weight about 1·5 kilos.; the primary coil had 100 turns of No. 16 wire, the secondary 10,000 turns of No. 40; r_1 had a resistance of 1 ohm, and the resistance of the primary coil was 0·107 ohm. The divergences of the observed ratio $v_2 : c_1$ from the value 10 are shown in Table I.

Table I.

Frequency. ~ per sec.	Error in ratio.
39	−1·9 per cent.
86	−0·8 „

The primary current at 1 volt (86 ~ per second) was 0·17 ampere. By inserting known resistances in the primary circuit the curve in fig. 2 was obtained, and thus it was proved that these divergences are (practically) entirely due to the ohmic drop of volts in the primary. If such a transformer is to be used on a circuit of nearly constant frequency, the ratio of the windings can be altered slightly so as to give an error almost negligible, or a few extra ends may be brought out to suit various frequencies. Perhaps an easier plan is to have a small range of adjustment on one of the parallel wires forming the low resistance r_1.

It is possible, however, to compensate for changes of frequency by Method 2*a*, shown in fig. 3. Here the total current, C, after

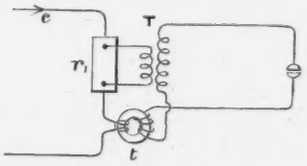


Fig. 3.

passing through the small resistance, r_1, passes through a turn or two on a very small compensating transformer, *t*, whose secondary is connected (reversed) in series with the secondary of T and the voltmeter. As the frequency is raised, the transformer, *t*, subtracts more and more from the voltmeter reading, and thus compensation can be secured.

The advantages of Method 2 are that with one voltmeter and a set of low resistances, a very wide range of currents can be measured; also no disturbing inductance is introduced into the main circuit.

It will be noticed that a transformer of high ratio like that described above gives a means of measuring small voltages with very small expenditure of current, but it is mainly to its use in conjunction with a low resistance that I would draw attention.

Measurement of Power.—For the measurement of power (or energy), transformers are often of great assistance, and in several

* *Philosophical Magazine*, p. 271, September, 1896.

well-known types of watt-hour meter they are employed with success. Under this head I shall content myself with mentioning two methods (3 and 4) shown in fig. 4, the first due to Mr. M. B. Field, and the second published recently by myself. In both of these a small resistance, r, is placed in series with the load, and S is a reversing switch. In Method 3 the voltage on the load is transformed down, and added and subtracted from that on r, giving resultants, P and Q, measured on a hot wire voltmeter. In Method 4 the voltage drop on r is transformed up, and the resultants, P and Q (similarly obtained), are measured on an electrostatic voltmeter. For both methods

$$\text{Watts} = \frac{P^2 - Q^2}{4\,m\,r}$$

where m is the ratio of the transformer.

Method 4 can be used with fair accuracy to measure power with power factors down to 0·1, or even lower. For this the resistance of the primary of the transformer must be made very small, so that the secondary voltage may be almost exactly in opposite power phase to the primary potential difference. (The small angular deficiency may be measured by Method 6 below.) For example, with 50 volts on the load, and 50 volts from the transformer, a power

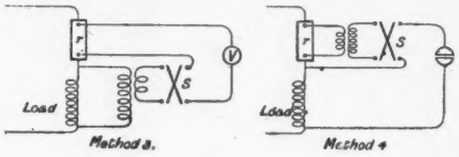


Fig. 4.

factor of 0·1 would give $P - Q \doteqdot 7$ volts, *i.e.*, the error of reading could be below 2 per cent., even on a voltmeter reading to 100 volts.

Method 5.—The three-voltmeter method, as usually employed, has several disadvantages; these are mainly due to the fact that, in order to get good readings, the auxiliary resistance must use up a considerable fraction of the total available voltage, and what may be worse, tends to alter the wave-forms in the circuit. In the two-voltmeter methods (3 and 4) this is avoided; there is, however, a simpler modification of the three-voltmeter method, which also gets over the difficulty. This is shown in fig. 5,* where r is a relatively small

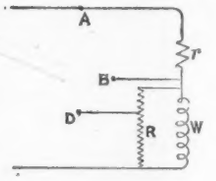


Fig. 5.

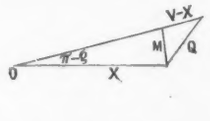


Fig. 6.

resistance, and R a very high resistance in parallel with the load, W. A convenient fraction $\left(\frac{1}{n}\text{th}\right)$ is picked off R by B, D, and the three-voltmeter method is applied to A, B, and D. The result multiplied by n gives the power taken by W. In another modification the resistance, R, is put across both r and W, but a more complicated formula is then required.

Method 6.—*Measurement of Power Phase Differences close to* 180°.

Let the effective voltages be V and X. (1) Let V be nearly equal to X, and let the small difference, V − X, be measured by an electrostatic voltmeter and a quick change-over key. Then Q, the small effective resultant of V and X, is found either by a low-reading voltmeter, or by the help of a phase turner, or a transformer of high ratio, and an ordinary range electrostatic voltmeter. Then, as will be seen from fig. 6,

$$\text{Sin. } \phi \doteqdot \frac{M}{X} = \frac{\sqrt{Q^2 - (V - X)^2}}{X}$$

(2) If V is not nearly equal to X, let a high resistance be put across the greater (say V), and v^1 a fraction of it picked off as nearly as possible equal X. v^1 and X are then combined as in (1). [The transformer must not be used here for measuring Q.]

I have found the above method useful for measuring approximately the power lag between the primary and secondary (open) potential differences in transformers.

In one case, for example, the lag was found to be (180° − 0·15°). Similarly, the lag between two independent voltages very nearly in phase, may be measured by reversing one of them, and proceeding as above.

* Mr. Addenbrooke uses a similar method in his electrostatic wattmeter.

Section B.—*The Testing of Watt-hour Meters.*

I. *Real Non-Inductive Loads.*—When sufficient power is available (at the proper frequency), the tests are usually easy, the chief difficulty sometimes being to find the gearing ratio between the quickest moving part and the dials, for some of the makers cannot be persuaded to mark this clearly on the meter.* When the loads

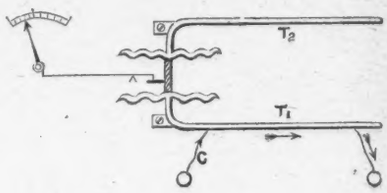


Fig. 7.

are above 2 or 3 kw., special non-inductive resistances are desirable in addition to lamps. I have found that a very convenient and cheap type of resistance frame for this purpose consists of strips of copper-nickel each 1 cm. broad, 1 metre long, and capable of carrying 50 amperes. As the strips sag with the heat developed they are pulled taut by light springs which pull at the middle points of the strips. With such frames a steady non-inductive load is easily obtained. Some meters are so much affected by inductance in the load that the introduction even of a small Kelvin balance (to measure the current) is undesirable. The want of a non-inductive ammeter in this and other cases led me, seven or eight years ago, to devise and make a thermal ammeter which, although I exhibit it now only as a curiosity, has some points of interest about it. It consists (fig. 7) of a form of differential air thermometer in which the bulbs are replaced at each side by thin-walled metal tubes T_1 and T_2 of small diameter (1 to 2 mm.); each of these is connected with a small aneroid chamber of extremely small internal volume. These chambers act against one another, and their differential action is magnified by ordinary aneroid mechanism as shown in the figure. The current to be measured is passed along the tube T_1 (or a set of tubes electrically in parallel) while the tube T_2 in the same enclosure acts as compensator. The use of the thin hot tube acting as its own air chamber is to give the maximum quickness in attaining steady readings. To compensate for the decrease in the expansibility of the air as the temperature rises, the hot tube was made of a material having a considerable resistance-temperature coefficient. Such a hot-tube ammeter, though non-inductive, dead-beat, and low in resistance, was scarcely accurate enough for careful testing work, but I think the principle is worth recording here.

(*To be continued.*)

* The Board of Trade might reasonably insist on this being done, I think.

REVIEWS.

On the Results of a Deep-Sea Sounding Expedition in the North Atlantic during the Summer of 1899. By R. E. Peake, M.Inst.C.E.

This valuable contribution to the world's knowledge of the depths of the sea, published under the auspices of the Royal Geographical Society, sets forth in a readable and condensed form much information gained during a comparatively recent expedition by the cable steamer *Britannia*, under the command of Captain H. Woodcock.

Like many previous surveys which have thrown entirely new light upon the conformation of the solid part of the earth's shell beneath the dark recesses of the ocean, this one was undertaken at the instance of two enterprising telegraph cable companies, both of them, be it noted, foreign competitors in the field, or rather the seas, for public favour in the electric transmission of messages to and fro between the old and new world.

The German Atlantic Telegraph, and the Commercial Cable Company, of New York, are to be credited with this latest acquisition in the shape of an extension of our knowledge, and of new facilities opened to the community at large for telegraphic intercourse with America—Marconi and Tesla not yet being serious rivals in the field.

The German Company's cable was completed last year, and the Commercial Cable Company will have, when complete, another line of cable between Ireland, the Azores and Nova Scotia, added to their existing system.

Messrs. Clark, Forde & Taylor, the engineers to both of

these companies, were the advisers for this detailed survey to be made over the route that their cables would have to follow.

The manner in which this work was accomplished is succinctly set forth by Mr. R. E. Peake, conjointly with Sir John Murray, the results being dealt with under four heads, viz., depths, bottom temperatures, currents, and nature of bottom.

The depths are considered in three divisions:—(1) The soundings between the British Islands and the Azores Bank; (2) those between the coast of North America and the Azores Bank; and (3) those in the vicinity of the Azores.

The first two lines of soundings were run between the Azores and British Islands; both developed uneven ground, the sea bottom sinking from the 1,000-fathom line off the S.W. point of Ireland down to 2,700 fathoms in lat. 45° 50′ N., 19° 40′ W., then shoaling to 2,145 fathoms, and afterwards more or less abruptly undulating until the shallow depth of the Azores Bank was reached.

From the position of the 2,145-fathom sounding, a shoal depth of 1,667, and then one of 1,410 fathoms were found, the latter in lat. 44°, N. lon. 22° W. This shoaling was considered to probably represent the summit of a submarine cone steep to the S.E., showing in 5 miles a drop of 6,000 ft., or, roughly, 1 nautical mile. Another submarine cone was discovered in lat. 43° 24′ N., lon. 28° 11′ W., with 1,200 fathoms on it, and sloping to the S.E. 3,000 ft. in 10 to 12 miles. From the summit of this latter the bottom deepens, then shoals, then dips again, finally shoaling gradually towards the Azores.

Following the more southerly line from the mouth of the English Channel, the depth increases gradually, slightly undulating to lat. 45° N., lon. 15° 53′ W., where a depth of 2,443 fathoms is found, thence, at 12 miles distance, is a sounding of close on 1,400 fathoms, this forming the summit of another submarine mountain with a hard crest, shown by the sounding tubes being empty, and the metal of the tube dented.

From this third elevation of over 6,000 ft. from the ocean floor the depth increases again to nearly 2,300 fathoms, then shoals to 2,000 fathoms, then falls gradually until a depth of nearly 2,800 fathoms is gained. Then the depth decreases to 2,200 fathoms. Two deep soundings of 3,284 and 3,265 fathoms succeed this undulating ground, forming a depression which has been named Peake Deep, the greatest depth yet recorded in this region. The deposit in this "deep" forms subject of remark in the voluminous notes on this branch of the survey. A remarkable fact cited is that less than 40 miles to the west of Peake Deep the *Britannia* discovered, by a sounding of 1,348 fathoms, another submarine mountain with a hard crest, fragments of volcanic glass only reaching the hands of the explorers. From this elevation the bottom falls away to 2,300 fathoms, rises again to 1,543 fathoms, and sinks again to over 2,000 fathoms, finally shoaling gradually on approaching the Azores.

Coming to the second division, which deals with the section of bottom between the Azores Bank and North America, we find it is stated that the more northerly of the two lines of soundings calls for little remark. The position of the greatest depth of 2,902 fathoms lies in the course of the Gulf Stream, lat. 41° 11′ N., lon., 40° 30′ W.; thence the ground gradually shoals towards the islands. The deposit from this, in common with other depths in this locality, shows something of the character of blue mud, owing to the influence of icebergs brought to the southward by the Labrador current.

The more southerly line of soundings on this section is recorded as extremely interesting, and is dealt with in greater detail. Off the American coast the depth was found increasing gradually to 2,300 fathoms, then shoaling to 1,675 fathoms in 39° 45′ N. lat., and 66° 16′ W. lon., this submarine elevation of over 3,600 ft. being apparently surrounded by much deeper water.

Three deep soundings of over 3,000 fathoms were found in 40° N. lat., 63° W. lon., one, of 3,318 fathoms, being the deepest found during the cruise. This depression has been called the Libbey Deep. From this eastward the bottom shoals to 2,800 fathoms, with two isolated deep casts *en route*, the name Sigsbee Deep being given to one of 3,045 fathoms, and that of Thoulet to one of 3,160 fathoms.

Eastward of this last "Deep," the bottom was found fairly uniform at depths of about 3,000 and 2,800 fathoms, through about 7° of longitude, then shoaling between longitude 47° and 49° to less than 2,000 fathoms.

This discovery, it is set forth, may be considered, from a cable-laying point of view, one of the most important results of the expedition, as it is evidently due to the "tail" of the Great Bank of Newfoundland extending much further to the south than was previously supposed. Eastward from this "tip of the tail of the Bank" the bottom falls to what may be called its normal level of between 2,500 and 2,800 fathoms, and then gradually rises on approaching the Azores.

The result of the survey of the Azores Bank presents many interesting features, the bottom around the group of islands, it is stated, being so irregular that none of the usual contour lines can be introduced as a limit to the bank, which, in fact, appears to be connected with an extensive ridge running north of the islands, and upon which several submarine elevations are situate. Isolated basins and peaks were discovered while sounding around, and depths of over 1,000 fathoms were struck comparatively close to several of the islands. The basins are probably extinct craters, and the cones old cinder heaps of lava and scoriæ belched forth in the far distant ages of the stormy youth of our world.

Depths south-west of the Island of Flores, on the line towards New York, show but little abnormal to the usual uniformity. Soundings north-east from the Island of Fayal have, however, it is stated, brought to light the existence of a vast depression equal in area to, and just to the west of, the Island of Graciosa.

Depths of over 1,300 fathoms were plumbed in this huge basin, the general level of the bank surrounding it being from 600 to 800 fathoms. This hollow, it is remarked, may possibly be an old submarine crater long since extinct.

Beyond Graciosa to the north-east, soundings show that the 1,000 fathoms contour develops a remarkable tongue-like extension of the Azores Bank with between 800 and 900 fathoms depth at its extremity.

To that section of the work of the survey most appreciated by the electrician—bottom temperature observations—assiduous attention has been paid, 151 observations being recorded from depths of 500 fathoms to over 2,000 fathoms.

One noticeable feature in the six observations taken off the coast of Nova Scotia in depths of less than 500 fathoms is that the distribution of temperature is quite the reverse of that found from the 12 observations taken in less than 500 fathoms on the Azores Bank.

In the former case the temperature increases gradually from 33·3° F. in 48 fathoms to 39·2° F. in 250 fathoms, while in the latter case the temperature ranges from 49·3° F. in 433 fathoms to 58·3° F. in 90 fathoms, showing a gradual decrease of temperature with increase of depth, this being in accordance with the distribution as invariably found.

At the mouth of the English Channel an observation showed a temperature of 51·4° F. at 336 fathoms, this being much the same as the temperature found on the Azores Bank at similar depth, but about 12° higher than the temperature observed off the American coast, at similar depth.

Another curious feature worthy of remark is that on the line of sounding from Flores to New York the temperatures are lower at similar depths than on the line from the same island to Nova Scotia, about 1° farther north. The bottom temperature in depths exceeding 3,000 fathoms, two only of which were obtained, viz., 36·4° F. in 3,160 fathoms in the Thoulet Deep off the American coast, and 37·4° F. in 3,284 fathoms in the Peake Deep off the European coast, is in the first case, only slightly above the minimum observed beyond 2,000 fathoms, and in the second case is the maximum observed beyond 2,000 fathoms.

In dealing with the question of currents, some remarks are made correcting the general idea that the Gulf Stream consists of a body of warm water moving steadily across the North Atlantic in the direction of the Irish Coast, it being

shown, by means of the excellent current charts published by the Hydrographic Department of the Admiralty, that this is not the case, but that the movement of this great volume of water is probably in the form of bands of current curving and recurving on one another, forming swirls of great extent, their strength and direction varying almost daily. The charts show that the Gulf Stream in its passage across the Atlantic spreads itself out fan-like, and forms what is known as the Gulf Stream drift.

A considerable number of current observations were taken by the *Britannia* during the sounding operations, a list of which is embodied in the book under review.

The classification and analysis of a large proportion of the 432 deposit samples has been most thoroughly done, and the percentage of area of the sea bottom between the parallels of 30° and 60° north latitude covered by the different classes of deposits divided out, showing that by far the larger part of the ocean floor within these limits consists of globigerina ooze, which is estimated at about 61 per cent. of the total. Blue mud comes next in importance, covering about 27 per cent., and red clay third with about 11 per cent. of the total. These three classes amount to no less than 98½ per cent., and the four remaining classes represented by green mud, volcanic mud, pteropod ooze, and coral mud, cover only 1½ per cent. of the entire area under consideration.

This is very striking, and not what one would expect from a cursory study of the subject, for the rivers of more than half the land of the globe discharge into the Atlantic, and the seas contiguous thereto.

Other facts of a striking character regarding the bottom temperatures are ably set forth, but there are limits to a reviewer's license, and we must content ourselves by saying that the book before us should occupy a prominent place as a work of reference on the bookshelf of those oceanographers and cable engineers who are so fortunate as to possess one.

Complete tables of the 477 soundings taken, showing positions, depths, and the 151 temperature observations, together with a perfect technical description of the bottom deposits, by Sir John Murray, are embodied in the work, and a most excellent map, incorporating the results of the *Britannia* expedition, 1899, is appended within the cover.

Yet another word or two in review of some of the prefatory remarks in the book.

It is very truly stated that the general interest aroused by the *Challenger* expedition, together with the requirements of the telegraph companies, have led to the continuous progress in our knowledge of the greater depths of the ocean, and that it is only within recent years that the telegraph cable companies have appreciated the importance of examining in a detailed manner the ground over which it is proposed to lay cables.

In a previous article reviewing a communication to the Royal Society of Edinburgh* on a deep-sea survey of a cable route between Turks' Island and Bermuda by the cable steamer *Britannia* in 1897, we drew attention to the remarkably sparse use of the sounding machine during the first 20 years or so (between the fifties and seventies) of submarine work in some parts of the world; when a line of soundings some 40 or 50 miles apart, for example, was deemed sufficient for an Atlantic cable, this being improved upon to a slight extent subsequently by, still single, lines of soundings between 20 and 30 miles apart for general cable laying purposes.

The system now generally adopted of sounding along a zigzag line within a band varying in width according to circumstances, was introduced more than 20 years ago in the Pacific, when zigzag lines of soundings were made, within bands varying in width between 5 and 20 miles, over a distance of nearly 2,000 miles, and carried out on still more extended lines in the early eighties by the Silvertown Company between Spain and the Canaries, when the Dacia Bank and Concepcion Bank were discovered.

After this a survey of the Western Atlantic was accomplished (in which Mr. J. Y. Buchanan took part) by the Silvertown Company's *Buccaneer* expedition so far south as the River Congo, where still more detailed work was carried out, and the extraordinarily-marked contour lines of the now well-known Congo Canon were discovered.

* Electrical Review, May 19th, 1899.

The reference made by the authors to this, is a just and graceful tribute to the enterprise displayed by the officers of the Silvertown Company, who were in responsible charge of the telegraph cable branch of that company's interest.

CURRENT SPECIFICATIONS.

LX.—ROCHDALE EXTENSIONS.

SUMMARY.

Extent of Contract No. 1.—Supply and erection upon prepared foundations of two steam dynamos, each of approximately 412 KW. output.

Type of Engine.—To be three-crank enclosed vertical tandem type.

Available Steam Pressure.—140 lbs. per square inch at stop valve.

Normal Load.—650 I.H.P. at a speed of 280 revolutions per minute when working condensing with a vacuum of 24 in.

Specified Overload.—800 I.H.P. for periods not exceeding 30 minutes.

Type of Dynamos.—Multipolar machines, with shunt winding for lighting work, but with series coil to render them suitable for use on traction circuits hereafter.

Output of Dynamos.—As shunt machine 860 amperes at 480 volts, as compound machine 750 amperes at 550 volts. To be capable of giving when overloaded for periods not exceeding 30 minutes, 517 KW. (940 amperes at 550 volts).

Permissible Temperature Rise.—After a six hours' run at 850 amperes 480 volts, not to exceed 60° F.

Specified Steam Consumption.—Not to exceed 26 lbs. per kilowatt-hour at full load with dry steam at 140 lbs. pressure and 24 in. vacuum. Tenderers to state what they will guarantee at full and half loads. Tests to be taken at makers' works before delivery, and also after erection at Rochdale.

Specified Dates of Delivery.—First set, January 1st, 1902; second set, September 1st, 1902.

Penalty for Late Completion.—One per cent. of contract sum per week.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages paid to Workmen.—Satisfactory; see comments below.

Terms of Payment.—75 per cent. of value of work executed or plant delivered on site on production of engineer's certificates, 15 per cent. on completion, 10 per cent. 12 months later.

Specified Period of Maintenance.—12 months after completion of work.

Arbitration Proposals.—Satisfactory.

Penalty for Failure to Fulfil Contract.—£1,000.

Date for Receipt of Tenders.—May 16th, 1901.

This specification has been issued by Messrs. Lacey, Clirehugh & Sillar, the consulting engineers to the Corporation. The technical portion has been drawn up with great care; in the tender a number of particulars and guarantees are asked for, and provision is made for offers of engines made by Messrs. Belliss & Morcom, Messrs. Browett, Lindley & Co., and Messrs. Willans and Robinson. It is open to tenderers to submit offers for triple expansion in place of the compound type specified. The overloads and permissible temperature rise at normal load are clearly stated, and they are in accordance with modern high-class practice.

The general conditions follow in their main outline the model form approved by the Joint Committee of the Municipal Electrical Association and the Electrical Plant Manufacturers' Association.

There is a comprehensive arbitration clause, disputes being referred to the final decision of two independent arbitrators, one of whom is appointed by either party, the terms of payment are fair, and the powers of the engineer are defined in a manner which may be accepted without fear by the contractor.

It is stipulated that the rates of wages shall be paid, and the hours and conditions of labour observed, in all work connected with this contract which have been agreed upon by both the Trade Unions and Employers' Associations as fair in the several trades concerned, any dispute as to standard rates being decided by representatives of both workers and employers' societies.

LXI.—LUDLOW ELECTRIC LIGHTING.

SUMMARY.

Extent of Contract.—Supply and erection of the plant necessary for a small central electric lighting station.

System.—Three-wire direct current system, with accumulators.

Size and Number of Steam Dynamos.—Two, each of 35 KW. output, 500 volts, machines to be shunt wound.

Type of Steam Engines.—To be of *highest* speed self-lubricating, two-crank compound type, made either by Messrs. Belliss and Morcom, Messrs. Willans & Robinson, or other approved maker.

Available Steam Pressure.—140 lbs. per square inch at stop valve.

Output of Engines.—Each to develop 58 I.H.P. as normal full load.

Permissible Temperature Rise.—Not to exceed 70° F. after 10 hours' run at full load of 70 amperes 500 volts.

Specified Overload.—10 per cent. for two hours without showing undue heating or sparking.

Steam Consumption.—Tests to be taken at maker's works before delivery for consumption at full, three-quarter and half load when exhausting to atmosphere.

Specified Date of Completion.—October 1st, 1901, provided buildings are ready to receive the machinery by August 1st.

Penalty for Late Completion.—Two amounts given, see comments below.

Stipulations as to Removal of Foreman.—Too stringent.

Stipulations as to Wages paid to Workmen.—None.

Stipulated Terms of Payment.—80 per cent. during progress of work, 10 per cent. on completion, 10 per cent. six months later.

Period of Maintenance.—Not expressly stated, six months implied.

Arbitration Proposals.—Thoroughly unsatisfactory. See comments below.

Date of Receipt of Tender.—June 3rd, 1901.

This specification has been prepared by Mr. John Parker, the city surveyor of Hereford, who was responsible for the installation recently set to work in that city, and who is acting as consulting engineer to the Ludlow Corporation.

We regret that we can do little but criticise unfavourably the manner in which the specification has been drawn up. In the one section before us—viz., No. 2—dealing with the generating plant there are several omissions and inconsistencies. Thus, in the advertisement it is stated that Sec. 2 comprises not only two 35-KW. steam dynamos, but also a "motor transformer and accessories." The most careful search of the specification itself fails to reveal any mention of the motor transformer, so that we are forced to the conclusion either that it has been forgotten altogether or else inadvertently included in one of the other sections.

The engines are to be of the "highest speed" type for the output made by Messrs. Belliss & Morcom, Willans and Robinson, or other approved maker, and the dynamos shunt wound, with a resistance in the shunt, variable at will, to give any voltage between 400 and 500 volts at constant speed. Delivery is asked for by October 1st next, or two months after the buildings are ready for the reception of machinery.

It is stated in the advertisement that tenderers may make offers for any or all of the complete sections, but not for portions of any section.

In the general conditions the penalty for late completion is stated to be 5 per cent. on the amount of the contract per month, or any part of a month.

In the tender itself, the penalty for late completion is said to be 10 per cent. per month or any part of a month, and only one form is given for offers for one or any number of the sections.

Thus not only is the penalty mentioned in the tender form, double that specified in the general conditions, but the amount of the penalty varies with the number of sections tendered for. The party making a complete offer is at a great disadvantage in comparison with the person who only tenders for one section, and whereas in the event of a complete tender for the whole of the work being accepted, and one item, say a steam dynamo being late, the corporation could penalise the contractor 10 per cent. of *the whole contract sum*—if the contract is divided, and the same thing happens, they can only fine the contractor 10 per cent. of the value of that one section. This we hold to be distinctly unfair, while the discrepancy between the amounts is inexcusable, and we strongly urge all tenderers to absolutely refuse to accept more than the generally recognised sum of *1 per cent. per week on the value of each separate section* which is late in completion.

We consider that the powers claimed by the engineer in regard to his power to object to and *dismiss* foremen or workmen in the employ of the contractor are far too arbitrary; he should be able to object to them, and to require the contractor to remove them, but the dismissing should be the act of the actual employer, not of the representative of the purchaser.

Two distinct clauses in the general conditions are headed "disputes," and in each it is distinctly laid down that the decision of the engineer on any matter whatever shall be final, conclusive, binding on both parties, and not subject to review.

We object to this refusal of arbitration on principle; it should always be open to either purchaser or contractor to refer any matter on which they cannot come to an agreement to an independent arbitrator.

In this case, when the conditions are laid down in such a manner that differences of interpretation can easily arise, we advise tenderers in every case to stipulate for the usual arbitration clause, and so guard against any possible dissatisfaction hereafter.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this Journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

8,227. "An improved apparatus for localising with the aid of the Röntgen rays and fluorescent screen metallic objects in the human body or other bodies." J. P. BENNETT. April 22nd.

8,280. "Improvements in or relating to accumulators or secondary batteries." R. FORTUN and E. SEMPRUN. April 22nd. (Complete.)

8,306. "'The Woodward-Toor' patent convex roller, electrical power transmitter for overhead or surface systems of electrically propelled traffic." T. O. WOODWARD and E. H. TOOR. April 23rd.

8,397. "Process and apparatus for treating mixed zinc blende and pyrites so as to render their separation by magnetic treatment possible and practicable." G. RIGG. April 24th.

8,402. "A new or improved combined system of electric lighting and fire alarms and appliances connected therewith." C. C. METCALFE. (H. C. Blackwell, Russia.) April 24th.

8,467. "Improvements in electric battery jars." A. FORD-LLOYD. April 24th.

8,475. "Improvements in brush-holders for dynamo-electric machinery." THE LANCASHIRE DYNAMO AND MOTOR COMPANY, LIMITED, and A. P. WOOD. April 25th.

8,478. "An automatic shunt for protecting electric arc lamps." A. ECKSTEIN and A. E. ANGOLD. April 25th.

8,495. "An improved form of field magnets for dynamos and electric motors." A. B. SOAR. April 25th.

8,518. "Improvements in electric meters." V. ARCIONI. April 25th. (Complete.)

8,535. "Improvements in electrically-lighting railway carriages and the like." J. E. SPAGNOLETTI. April 25th.

8,550. "An improved electric arc lamp." R. O'BRIEN. April 25th.

8,563. "Improvements in intercommunication telephone systems." B. BRANDER. April 26th.

8,615. "Improvements in electric arc lamps." F. M. LEWIS. April 26th.

8,629. "Improved means applicable for use with overhead electric conductors for the prevention of danger in case of fracture." R. P. WILSON. April 26th.

8,648. "Improved automatic electric exchange apparatus." W. L. WISE. (The American Machine Telephone Company, United States.) April 26th.

8,653. "Improvements in starters for electric motors." W. R. RIDINGS and VERITYS, LIMITED. April 27th.

8,677. "Improvements in or connected with trolley heads or electric current collectors." R. M. TYRER. April 27th.

8,716. "An improvement in continuous-current dynamo-electric machines." O. A. ZANDER and B. INGESTROM. (Date applied for under Patents, &c., Act, 1883, Section 103, October 12th, 1900, being date of application in Sweden.) April 27th. (Complete.)

8,717. "Improvements in or relating to secondary cells or batteries." W. FRITSCHE. April 27th.

8,720. "Improvements in differential alternating current arc lamps." W. MATHIESEN. April 27th. (Complete.)

8,724. "Improvements in and connected with controlling switches for use in electric light systems and for analogous purposes." J. T. ARMSTRONG and A. ORLING. April 27th.

8,727. "Improved gripper for electric or other cables or ropes." W. T. HENLEY'S TELEGRAPH WORKS COMPANY, LIMITED, and R. O. WRIGHT. April 27th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

13,565. "Improvements in method of, and apparatus for, controlling electric current motors." The British Thomson-Houston Company, Limited. (A. H. Armstrong.) Dated June 30th, 1899. Relates to the control of alternating current motors by

connecting them in series or parallel, or in △ or Y connection. The invention is described with reference to a diagram, which is too complicated for purposes of abridgment. 12 claims.

13,656. "Improvements in brakes for electric motor vehicles." H. Leitner. Dated July 1st, 1899. Relates to means for applying brakes on electric motor vehicles, consisting of two ironclad electro-magnets of opposite polarity, having a U-shaped armature with its limbs extending as cores into the magnet coils. The armature is provided with suitable connections to the vehicle brake. 2 claims.

13,732. "Improvements in apparatus for exciting alternating current dynamos." C. D. Abel. (La Societe Anonyme pour la Transmission de la Force par l'Electricite.) Dated July 3rd, 1899. Relates to an exciting apparatus whereby an alternating current dynamo is made to furnish currents of constant intensity or voltage. The exciter is composed of two continuous-current armatures mounted on the same shaft and having the several sections of their windings connected together and to a single commutator. Each section of one winding is connected between two successive commutator segments in parallel with a symmetrically-disposed section of the other winding. The armature is surrounded by an ordinary continuous-current machine inductor, the winding of which is connected in series with the circuit supplied by the exciter. The other armature is surrounded by two inductor rings similar to those asynchronous monophase or polyphase machines, the circuits of one being connected in series, and those of the other in shunt, with the armature of the alternator. Reference is made to Specification No. 22,833, A.D. 1896. 3 claims.

13,773. "Improvements in electric traction on a road contact or like system." S. P. Thompson and M. Walker. Dated July 4th, 1899. Electric railways and tramways on a road contact system with switches operated by magnets on the vehicle. Conductors.—The car carries two skates in tandem and the studs are normally connected to the low potential main, but are connected to the high potential main and then restored to the low potential by the passage of car magnets over them. These magnets act through vertical moving plungers under the studs, and the plungers move the switch arms by means of ratchet gearing and crank discs or otherwise. In some cases, an exposed stud is lifted by a magnet on the car. This stud is carried by a pivoted lever in an insulated mounting under the non-magnetic lid of the box, which is provided with a drip flange. The flattened part of the lever works between lugs on the cast iron box to reduce the magnetic reluctance. The pivot may pass into a watertight box to carry an arm which makes contact with a feeder from the main. Or this arm may close the circuit for a shunt current from the skate through a magnet coil to earth or return to lift an armature which completes the circuit from the main to the stud. The provisional specification also states that a switch armature may be moved parallel to the road by an inclined magnet on the vehicle. 4 claims.

13,819. "Improvements in automatic and magnetic circuit breakers." C. E. Starr. Dated July 4th, 1899 Relates to magnetic cut-outs. The arm which carries the contacts is pivoted and is held up by the pin fitting in a recess in the latch pivoted to a supporting-bracket. The operating-solenoid or electro-magnet is fitted in the arm, and its core is provided with a yoke embracing a lever pivoted on the pin. In one construction when the core is raised, the lever is tilted and a shoulder strikes the nose of the lever, so releasing the arm which falls over, being assisted by a spring, and breaks the circuit. In another construction when the lever is tilted it tips a weighted lever which falls on to the end of the lever, and so releases the switch arm. 9 claims.

13,846. "Improvements in and relating to the manufacture of a composition from rhea fibre applicable for electric insulation and other purposes." W. J. Gardner. Dated July 4th, 1899. Relates to the treatment of rhea fibre and its mixture with gums, resins, india-rubber, gutta-percha, &c., for preparing electric insulating compositions, india-rubber compositions, and plastic compositions for various purposes. The Provisional Specification refers to applying the composition to golf balls and pulleys. The rhea fibre is cleaned, dried, and regummed. The fibre is then treated with silicate of soda, and is dried, after which it is immersed in resin or heavy hydrocarbon, the excess being removed by a hydro-extractor. The rhea is then dried at about 250° F., until converted to cellulose, when its fibrous nature is destroyed in a mixing machine. The broken-down rhea is then mixed with oils, resins, india-rubber, gutta-percha, &c., as desired for the various purposes, the oils being oxidised as required. 4 claims.

13,849. "Improvements in electric incandescent lamps." J. Atherton. Dated July 4th, 1899. Incandescent lamps. A bayonet or screw cap is made with two slots corresponding to grooves formed in the neck of the bulb, and is secured against a shoulder on the neck by a wire laid in the slots and grooves, and having its ends twisted together. The bulb may have a long neck which can be divided by a hot wire or otherwise, for replacing a filament, and afterwards rejoined. The new filament is previously mounted on short wires, which are attached to the original leading-in wires. 2 claims.

13,930. "Improvements in magneto-electric and dynamo-electric generators." F. Byran and Major A. H. Bayly. Dated July 6th, 1899. Relates to magneto-electric and dynamo-electric generators, more particularly intended for use in igniting the charge in explosion motors. The fly-wheel has one or more permanent magnets or electro-magnets mounted upon it so as to be in running balance with it and provided with polar extensions. An arm mounted adjustably on the motor shaft carries one or more generating coils which are connected with the igniting device either directly or through an induction coil. The arm is capable of adjustment relatively to the fly-wheel so as to allow of the maximum current being generated at any desired moment. In an arrangement described in the provisional specification the generating coils are arranged on the poles of stationary magnets, and currents are generated by moving pass them armatures (inductors) carried by the fly-wheel. 2 claims.

13,939. "Improvements in electric railways and tramways on a sectional conductor system." J. Milnes. Dated July 6th, 1899. Electric railways and tramways on a sectional conductor system with switches opened by magnets on the vehicle. Conduits, conductors, switches.—The main conductor is supported on insulators on brackets inside a closed conduit, and is provided with upwardly extending bare branches or loops over, or on which work sliding caps or rings or pivoted pieces. These are lifted by magnets on the vehicle to make contact with the underside of sectional conductors lying in or forming the base of the groove in the insulating top of the conduit. The magnet may run in the groove containing the sectional conductor or in a separate one, and this conductor may be imbedded in the conduit. Wood, stone, or the like, or insulated metal can be used for constructing the conduit. The moving part of the switch may be a tube with a flat closed top, or a hinged plate or a ring guided by an insulating rod. The conductors are sloped towards their ends to shed water. 1 claim.

13,951. "Improvements in or relating to monophase electric motors." W. P. Thompson. (E. Cantono.) Dated July 6th, 1899. For the purpose of starting an asynchronous or synchronous monophase motor, the armature is disposed in a longitudinal direction, and is so arranged that, when current is supplied to the motor, it is returned to its normal position by the action of the magnetic field, the motion of translation being converted into a helicoidal movement by a screw and nut or equivalent device. In one arrangement the shaft of the armature carries a short screw engaging with a pin carried at one end of a lever. For starting in one direction the armature and lever are arranged in one position; for starting in the opposite direction they are arranged in another position. 1 claim.

13,994. "An improved key switch for electrical circuits, particularly adapted for incandescent lamp sockets." Veritys, Limited, and W. R. Ridings. Dated July 6th, 1899. Switches particularly adapted for lamp sockets. A rocking bar is centrally pivoted and adapted to make contact with two spring contacts. It is connected by a spring to an arm adapted to be turned by the key. When the key is turned, the spring is extended until it passes the dead point, when the spring snaps the switch bar on or off. This arrangement also provides for a rubbing action on the contacts. 3 claims.

13,995. "Improvements in and relating to the carbon feeding mechanism of electric arc lamps." Veritys, Limited, and W. R. Ridings. Dated July 6th, 1899. Arc lamps:—Brake regulating mechanism is constructed as follows:—The heavy upper carbon-holder and the lower holder are connected by a cord passed over a small pulley, and round another pulley attached to the brake wheel. The small pulley is carried by one end of a lever, the other end of which has a screw to bear against the top of the lamp frame. The brake is a cord attached to the pulley lever near the screw, passed round the brake-wheel, and attached on the series side to a regulating-lever, which carries cores over series and shunt solenoids. As the carbons burn, the series core rises, allowing the brake-wheel to turn under the action of the weight of the upper holder, until the screw touches the top of the lamp frame; further movement of the series core slackens the brake cord so that the brake-wheel slips. 3 claims.

13,996. "Improvements in electric arc lamps." Veritys, Limited, and W. R. Ridings. Dated July 6th, 1899. Arc lamps. Relates to carbon-controlling mechanism. The upper carbon holder is hung from a cross-piece, provided with three rollers to run on a vertical tube, a bifurcated part embracing a frame rod, and an oval or other non-circular slot fitting a corresponding rod loosely. This rod is supported rotatably on arms of the tube, and this is movable vertically on another frame rod. The invention is described with reference to a diagram which is too complicated for purposes of abridgment. 5 claims.

14,033. "Means for constructing a thermopile and for utilising solar rays and other energy for the purpose of generating, transmitting, storing, and using thermo-electricity." R. M. Dunn. Dated July 7th, 1899. Relates to a thermopile or "heliopile" for utilising solar rays and other energy in order to generate a thermo-electric current, which may be transmitted directly for use or stored by accumulators. The couples are insulated from one another by a material or composition such as glass or gutta-percha or other substance combined with "phosphuret of nitrogen" or nitrogen gas in a solution of phosphorus, or it may be asbestos, or the like forming a roofing, opaque or transparent, for buildings, and a container for the couples. Focussing glasses are employed to concentrate the solar rays on the exposed junctions, which may be coated with lampblack. A glass tube through which liquefied gases or water or steam may be passed is employed to cool or heat the unexposed junctions. The pile may be arranged so that it may be moved or tilted by means of a plate with holes to receive a fastening-bolt, or the apparatus may be on a swivel. The pile may be of oblong, circular or other form, and may vary in size from one eighth of an inch square to a surface 20 acres in extent. 6 claims.

14,055. "Improvements in apparatus or means for collecting and removing from pickling vats the scale or magnetic oxide removed from the plates subjected to the pickling process." S. C. Cowper-Coles. Dated July 7th, 1899. Magnetic oxide or scale, removed from plates, is collected from a pickling-vat by a magnetic separator, consisting of electro-magnets contained in a copper or other acid-proof casing, and connected by wires passed through a tube to terminals on a supporting bar; the magnets are wound to have like poles downward. The separator is removed from the vat at intervals, and the scale brushed or scraped off the casing. 3 claims.

14,207. "Improved telephone apparatus." L. G. Benard. Dated July 10th, 1899. Relates to telephonic apparatus for house or other arrangements, and embodies an annunciator with contacts for closing the local bell circuit, and a switch for changing the signalling and telephone circuits by a combined transmitter and receiver. A frame with label is mounted on an axle provided with a resetting button. The frame is held in its vertical position by a latch spring on the armature of the electro-magnet. The armature carries a spring contact for closing the bell circuit, and has a resetting leaf spring. Two springs connect the indicator and telephone circuits. A slide rod in connection with one line carries a T-piece which makes contact with one or other of the springs. The telephone has a microphone mounted on one diaphragm in a case, the opposite end of the case being closed by a diaphragm, behind which are placed the magnet coils and the polarising-magnets. 4 claims.

14,224. "Improvements in or relating to apparatus for electrically transmitting orders, signals, or indications from one place to another." A. U. Alcock. Dated July 10th, 1899. Relates to electrical apparatus for transmitting orders, signals, or indications from one place to another, and applicable as a military or ship's telegraph, or as a speed counter, &c. In one arrangement, the receiver is similar in construction to the transmitter, which comprises three pairs of coils symmetrically arranged on a ring-shaped field-magnet to act on the armature of the spindle which carries the pointer. The coils of each pair are connected in series with each other and, through the leads, with the corresponding coils of the receiver, the other ends of the receiver coils being connected together. The coils of the transmitter are separately connected through the leads to the fixed electrodes of the electrolytic commutator, which comprises a cell containing a suitable electrolyte such as an acid or alkaline solution, or distilled water, the fixed electrodes and two diametrically opposed electrodes mounted so as to be capable of rotation within the cell. The electrodes are connected to an electric generator supplying alternating, pulsating, or direct current. In operation, the movement of the electrodes by the operator produces a variation in the magnetic field of the coils which causes the pointers of the transmitter and receiver to follow exactly the movement of the electrodes. When direct currents are employed the armatures may be permanently polarised, but when alternating or varying currents are used, the armatures are preferably polarised by coils connected to a secondary winding of the transformer. The pointers may also be rendered dead beat by an electro-magnetic brake acting on their spindles. A number of receivers may be connected in series with a single transmitter. Another form of transmitting commutator is adapted to give 12 indications in a complete revolution. The generator is connected to the fixed brushes, which are adapted to make contact with the three arc-shaped segments. These segments are mounted on a revoluble insulating block and are connected separately to the coils of the field-magnet. A modification of this arrangement is described in which a supplementary commutator is employed to obtain 24 indications in one revolution of the pointers. When the indications to be sent are, for example, represented by degrees, minutes and seconds, the pointers may make two or more revolutions to indicate 360°, in which their spindles are geared to suitable counters indicating the number of complete revolutions. In a modification, the dial plate is formed with a spiral scale, and a corresponding spiral groove, extending through two or more complete revolutions, and the pointer, which is radially extensible, is caused to work over the scale by engagement with the groove. A switching arrangement is also described, which enables the instrument at either of two connected stations to be used for both transmitting and receiving purposes. When used as a speed counter the movable part of the commutator is operated by the rotating body, the speed of which is to be indicated, and the spindle of the receiver is geared to a counting mechanism. 10 claims.

14,235. "Improvements in apparatus for measuring time by electricity." M. Hooft. Dated July 10th, 1899. A rotary oscillating armature bearing a pawl drives a rachet-wheel as the circuit is made and broken between a radial finger which projects from a jumping disc and a tangential contact-plate upon a non-reversal pawl, backed by a spring. The length of each driving interval is determined by a train, ending in an escapement. 6 claims.

14,250. "Improvements in or appertaining to casings for electric light and similar cables." A. Hudson and C. J. Wightman. Dated July 11th, 1899. Wooden casing for electric light, &c., leads is enclosed in a two-part metal case, straps securing the metal casing in position. Similar junction-boxes are formed with side openings to receive the wood casing for main and branch leads. 2 claims.

14,328. "Improvements in insulators for the overhead conductors of electric tramways." W. L. Wise. (The Action-Gesellschaft Elektricitatswerke vormals O. L. Kummer & Co.) Dated July 11th, 1899. Electric railways and tramways with overhead conductors. Conductors, supports for.—To maintain the trolley wire in proper position on curves, one of the arms by which the insulator is attached to the span wires is bent upwardly so that the turning moments of the span and trolley wires are balanced. The arm may have one or more points of attachment for the span wire, or the arms may have oppositely-directed hooks to fit over a span wire that has been fixed. In this case a slotted bolt and nut secure the insulator on the wire. 4 claims.

14,668. "Improvements in and connected with movable electric lights." H. O. Farrell. Dated July 17th, 1899. Supporting lamps. Any part of a passage is lighted by a conductor from a ring, which slides on a wire extending between two brackets fixed on the ceiling or otherwise at the ends of the passage. The flexible conductor extends round two pulleys to a ceiling rose, and the ring is also connected to a cord which passes round two other pulleys and holds up the conductor in any position of the ring on the wire. 2 claims.

"Electrical Review" List o

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PLACE.	Lighting Authority.	System of Distribution.	Boilers.	Type and Size of Engines.	Type of Generators.	Size of Generators.	System of Driving.	o
PROVINCIAL.								
(1) Aberdeen.....	Corporation	3 wire at 220 and 440 v.	8 B. & W...	2 38 h.p., 3 80 h.p., 2 200 h.p., 2 300 h.p., 1 600 h.p., Willans; 1 650 h.p, Belliss	E.C.C., Holmes, Crompton, Bruce Peebles, Mather-Platt, Westinghouse	2 23 kw., 3 48 kw., 2 120 kw., 2 180 kw. 1 390 kw., 1420 kw.	Direct ..	N
(2) Alderley and Wilmslow	Electric Light Co.....	3 wire	2 Davey-Paxman loco.	2 75 h.p., Belliss	Ediswan 2 pole under type..	46 kw.	Direct ..	N
(3) Ashton-under-Lyne	Corporation	3 wire	4 Lancs., 2 m'tubular	3 vert. enclosed 500 h.p., Browett-Lindley	3 P. R. Jackson's, with Sayers winding	300 kw. each	Direct ..	C
(4) Bangor (N. Wales)	Corporation	3 wire	2 Hornsby water tube	2 100 i.h.p., Willans	Fowler.....	2 60 kw.	Direct ..	N
(5) Barnsley.....	Corporation	3 wire	3 Lancs. ..	3 125 h.p., 1 250 h.p., Willans; 1 180 h.p., Browett-Lindley	Johnson-Phillips	3 75 kw., 1 150 kw., 1 100 kw.	Direct ..	N
(6) Barrow-in-Furness	Corporation	2 wire, 250 & 1,100 v. fds. 220 v. distrb.	4 B. & W...	3 125 h.p., Universal; 1 250 h.p., Willans	3 Universal, 1 Bruce Peebles	3 75 k.w., 1 150 kw.	Direct ..	C
(7) Belfast.....	Corporation	3 wire	6 Lancs., 2 water tube	2 60 h.p., 4 120 h.p., gas engines; 2 175 h.p., 2 350 h.p., 4 700 h.p., Belliss	2 pole under-type; 6 2 pole, 4 multi-polar	2 26 kw., 4 57 kw., 2 200 kw., 4 50 kw., 4 500 kw.	Rope and direct*	C
(8) Bexhill.....	Urban District Council..	3 wire	2 Hornsby water tube	2 150 h p., Allen.....	Allen	2 100 kw.....	Direct ..	N
(9) Bilston.....	Urban District Council..	2 wire	2 loco., 1 Cornish	2 37 h.p., 1 50 h.p.	Brush, Paterson and Cooper, and E.C.C.	1 12 kw., 1 15 kw., 1 18 kw.	Rope....	N
(10) Birkenhead....	Corporation	3 wire	3 Lancs. ..	3 80 i.h.p., 2 240 i.h.p., 1 360 i.h.p., Willans	Crompton, Siemens, and Mavor-Coulson	3 50 kw., 2 150 kw., 1 225 kw.	Direct ..	N
(11) Birmingham ..	Corporation	3 wire	Lancs.	Willans and Belliss	Crompton, E.C.C., & Mather-Platt	—	Direct ..	N a
(12) Blackburn † ‡ ..	Corporation	3 wire con. cen. area, 3 & 2 wire alternating to outer districts	6 Lancs. ..	2 80 h.p., 2 100 h.p., 2 200 h.p., 1 360 h.p., Willans; 2 250 h.p., 1 360 h.p., 1 770 h.p., Belliss	Siemens, Mather-Platt, and E.C.C.	2 45 kw., 2 120 kw., 2 150 kw., 1 225 kw., 1 500 kw. con.; 2 60 kw., 1 200 kw. alternating	Direct ..	P
(13) Bolton † ‡	Corporation	3 wire	9 Lancs. ..	2 1,000 h.p., 2 500 h.p., Musgrave	Mather-Platt 12 pole	2 600 kw., 2 300 kw.	Direct ..	B
(14) Bootle.....	Town Council.....	3 wire	Lancs.	2 125 h.p., 3 250 h.p, Belliss....	Parker.....	2 75 kw., 3 150 kw.	Direct ..	C
(15) Bradford	Corporation	3 wire	4 Lancs., 6 marine, 2 water tube	1 150 h.p., Marshall; 2 150 h p., 2 200 h.p, 2 300 h.p., 2 340 h.p., 2 350 h.p., 5 600 h.p., Willans	Siemens and E.C.C.....	1 85 kw., 2 82 kw., 2 125 kw., 2 175 kw., 2 210 kw., 2 375 kw., 5 380 kw.	Direct ..	C
(16) Bridlington	Town Council.....	Series	—	Otto gas engine 42 b.h.p.....	Thomson-Houston series....	18 arc lighter	Belt	
(17) Brighouse.....	Corporation	2 wire	—	Gas engines, 1 7 h.p., 1 14 h.p. 1 20 h.p. nominal	Kapp	1 7 kw., 1 13 kw., 1 16 kw.	Belt	
(18) Brighton ‡	Corporation	3 wire D.C. & H.P. A.C., with sub-stations	6 Lancs., 8 B. & W.	2 80 h p., 2 200 h.p., 4 360 h.p., 6 800 h p., Willans	6 multi-polar, 8 bi-polar	2 45 kw., 2 120 kw., 4 220 kw., 6 500 kw.	Direct ..	C
(19) Bromley (Kent)	Bromley Electric Light and Power Co., Ltd.	3 wire, & 2,000 v. to supply Chislehurst	3 Dy-Pxmn. economic	3 120 h p., 2 360 h.p., Belliss	Parker	3 84 kw., 2 180 kw.	Direct ..	C
(20) Buckingham ..	Buckingham Elec. Light and Power Supply Co.	2 wire	Cochrane semi-port., Marshall	1 horizontal, 1 semi-portable, 40 h.p. and 24 h.p.	Elwell - Parker, Goolden, Greenwood-Batley	2 9 kw., 1 10 kw., 1 40 kw.	Belt and counter-shafting	N
(21) Burnley	Corporation	3 and 5 wire	3 Lancs. ..	2 120 h.p., 1 250 h.p. horizontal, 2 420 h p. vertical, Belliss	Elwell-Parker and E.C.C. ..	2 90 kw., 1 120 kw., 2 330 k.w.	Rope and direct	C
(22) Bury	Corporation	3 wire	3 Lancs. ..	2 210 b.h.p., 2 360 b.h p., Belliss	——	2 130 kw., 2 250 kw.	Direct ..	C
(23) Bury St. Edmunds	Corporation	3 wire	Lancs.	Belliss	——	60-66 kw.....	Direct ..	N
(24) Buxton	Urban District Council..	3 wire	3	2 150 b.h.p., 2 40 b.h.p.	Mather-Platt	2 75 kw., 4 12 kw...	Direct ..	C
(25) Canterbury....	Town Council.....	3 wire	3 Lancs. ..	2 125 b.h p., 1 250 b.h p.....	India-rubber & Gutta Percha Co.	4 38 kw., 2 75 kw...	Direct ..	K c
(26) Carlisle.....	Corporation	3 wire	5 Lancs. ..	2 100 i.h.p., 2 200 i.h p., 2 400 i.h.p., Willans	6 Siemens, 2 Peebles	4 30 kw., 2 125 kw., 2 250 kw.	Direct ..	L c
(27) Chester.....	Corporation	3 wire	7 water tube	3 150 h.p., 3 450 h.p., Belliss....	Parker	3 80 kw., 3 250 kw.	Direct ..	C
(28) Chislehurst....	Chislehurst Electric Supply Co., Ltd.	3 wire	(supplied with 2,000 volts continuous current from Bromley)		Parker	2 40 kw. motor trans.	—	
(29) Colchester	Town Council.....	3 wire	3 Paxman economic	3 100 i.h.p., 1 360 i.h.p., Peache	Siemens	3 60 kw., 1 220 kw.	Direct coupled	Su
(30) Cork	The Cork Elec. Tramways and Lighting Co., Ltd.	3 wire	B. & W. ..	3 200 kw., Macintosh-Seymour; 2 300 kw., Allis	Thomson-Houston	3 200 kw., 2 300 kw.	Direct ..	C
(31) Crewe.....	Corporation	3 wire	3 Lancs. ..	3 Willans	3 Mather-Platt	2 200 kw., 1 120 kw.	Direct coupled	L t
(32) Darlington	Corporation	3 wire	2 Lancs. ..	2 50 h.p., 2 150 h.p., Scott-Mountain	Scott-Mountain	4 17 kw., 2 100 kw.	Direct coupled	N
(33) Darwen.....	Corporation	3 wire	3 Lancs. ..	2 250 h.p., 1 450 h.p., Belliss	Siemens and Mather-Platt ..	2 150 kw., 1 300 kw.	Direct ..	C o
(34) Dewsbury	Corporation	3 wire	3 Lancs. ..	2 180 h.p., 1 80 h.p., 1 55 h.p., 2 250 h p., Willans	Crompton and Peebles.....	2 100 kw., 1 50 kw., 1 30 kw., 2 125 kw.	Direct ..	N
(35) Doncaster	Corporation	3 wire	3 Lancs. ..	3 90 i.h.p., 2 240 i.h.p., Willans..	Mather-Platt	3 56 kw., 2 150 kw.	Direct ..	N (a
(36) Dudley	Corporation	3 wire	4 B. & W...	3 350 h.p., 1 250 h.p., Westinghouse	Westinghouse	3 200 kw., 1 100 kw.	Direct ..	C
(37) Dundee	Corporation	3 wire	8 Lancs. ..	11 = 2,226 h.p., 1 750 h.p. erecting	Siemens and Parker	40 kw., 80 kw., 120 kw., 300 kw.; 500 kw. erecting	Direct ..	C
(38) Edinburgh ‡ ..	Corporation	3 wire, D.C. & high press. A.C.	Marine and water tube	100 to 1,200 h.p., Willans	Various	60 to 780 kw.	Direct ..	N
(39) Fleetwood and District	Fleetwood and District Elec. Lt. and Pwr. Synd.	3 wire	2 B. & W...	2 110 i.h.p., Willans.....	Johnson-Phillips	60 kw.	Direct coupled	N
(40) Folkestone	Folkestone Electricity Supply Co., Ltd.	3 wire	Paxman's economic	2 120 h.p., 2 250 h.p. Peache	Parker	2 160 and 460 v., 2 370 and 460 v.; 2 320 kw. 2 500 v. adding	Direct ..	N

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ors.	System of Driving.	Condensing or Non-condensing.	Type of Mains.	Number of Arcs and equiv. 8 C.P. Incandescents used in Private Lighting.	Number of Lamps used in Street Lighting, Arc and Incandescent.	Number of 8 C.P. Lamps added during past 12 months.	Price Charged to Private Consumers.	System of Charging.	Type of Meters Employed on Consumers' Premises.	Present actual Capacity of Works in kw.	Nature of Fuel used.	Total Cost of Construct-ing and Equipping Works.	Cost of Mains.	Annual Revenue per 8 C.P. Lamp Installed.	Number of High Voltage Lamps used.	D Pr Co Te
kw., 0 kw. 0 kw.	Direct ..	Non-condensing	Bare copper, Callender, B.I.W., and Siemens	56,825 8 c.p.	204 10 amp. arcs, 180 incand.	13,654 ..	Ltg. 6d. & 3d., pwr. 3d. & 1d	Brighton, M.D. system	Ferranti and Thomson	1,600	Coal	£51,115 July,	£42,251 1900	About 4/9	Used exclusively	220
....	Direct ..	Non-condensing	Callender, ld. covd. and armd. fdrs. triple conc., dis. 3-core	2,600.....	—	1,400....	7d. & 4d., and 6d. prepmnt.	Brighton & prepay-ment	Hookham, Reason, Long-Schattner	92	Stafford burgie	£16,074	£8,300	—	—	210
....	Direct ..	Condensing plant erecting	Conc. B.I.W., lead covd., in Doulton pipes	71 arcs, 8,150 8 c.p.	72 arcs, 150 incand.	1,845....	Lighting 4½d., power 3d.	Flat rate	Hookham	900	Bolsover slack	—	—	—	—	200
....	Direct ..	Non-condensing	B.I.W. paper, triple conc. ..	5,500 8 c.p.	—	Commenced Oct., 1900	5d.	Flat rate	Bastian, Ferranti, Schattner (prept.)	120	Coke and refuse	—	£6,000	—	All.....	200
kw.,	Direct ..	Non-condensing at present	B.I.W. solid, and 3 core armd. direct	—	30 arcs, 50 incand.	—	Ltg. 7d. & 3d., power 1½d.	Brighton	Hookham and Reason indctr.	475	Slack	—	—	—	—	230
0 kw.	Direct ..	Condensing plant erecting	B.I.W. conc.	15,055 8 c.p. equiv., inc. motors	22 10 amp. arcs, 44 16 c.p. incan.	5,778	Ltg. 6d. & 3d., pwr. 3d. and 1½d.	Brighton	Ferranti and Hookham	375	Yorkshire nuts	£32,500 (approx.)	£7,000 (approx.)	7/- (apprx.)	All.....	220
kw., 50	Rope and direct*	Condensing....	Bitumen cable in stoneware casing, c.i. pipes & solid	75,000 8 c.p.	—	23,000 ..	Ltg. 6d. & 2d., pwr. 3d. & 1½d.	Wright's	Hookham and Ferranti	2,850	Engl'h slack and nuts	—	—	5/1 in '99 4/- in '00	All.....	220
....	Direct ..	Non-condensing	B.I.W. triple conc., lead covd. and arm'rd	7,310 8 c.p.	26 arcs, 332 32 c.p.	9,015....	7d. and 3d.	Wright's	Hookham and Reason (prept.)	200	Best Welsh	£24,000	£10,000	—	—	220
kw.,	Rope....	Non-condensing	Armoured	—	16 arcs	120	—	—	—	45	Coal	£3,000	£200	—	None	
kw.,	Direct ..	Non-condensing	Callender and B.I.W.	100 arcs, 19,192 8 c.p.	14 arcs, 10 incand.	4,890....	Ltg. 6d. to 1½d., power 4d. to 1½d.	Discounts	Ferranti and Hookham	675	Slack	—	—	—	All.....	230
	Direct ..	Non-condensing and condensing	Callender, in c.i. conduits ..	150,944 8 c.p. lamps	None.....	—	7d.	Sliding scale	Hookham and Ferranti	—	—	—	—	—	—	
w., 2 w., 1 0kw., ating	Direct ..	Part condensing	L.T. rub. in c.i. conduits, alterng. feed. conc. arm'rd	22,793	76 arcs, 239 incand.	—	Ltg. 6d. & 3d., power 2½d. & 1½d.	Brighton	Hookham, Ferranti, and Thomson	1,675	Slack	£51,553	£29,882	5/10	Used on outskirts of L.T. area	110 220 v. wa
kw.	Direct ..	Both.....	Triple concentric paper, B.I.W.	—	—	—	—	—	Ferranti	1,800	Slack	£45,000	£5,000 (feeders)	—	—	230
kw.	Direct ..	Condensing....	B.I.W.....	8,588 8 c p.	80 arcs, 180 incand.	—	Ltg. 5d. & 3d., pr. 5d. & 1½d.	Wright's	Hookham	—	Slack	—	—	—	—	220
v., 2 kw., 375	Direct ..	Condensing....	B.I.W., armoured and lead covered cables, laid in ground	172,741 8 c.p. (inc. 805 arcs)	51 arcs (12 with 2 50 c.p.)	In. 12,360, arcs 1,290, mts. 26,458	Ltg. 4½d., 2½ % dis. and free lmps., pwr. & ltg. 2d. intmt.	Flat rate	Thomson, Hkham., Ferranti, Bastian, and Aron	3,569	Yorkshire nuts, coal	£202,703 (31	£79,564 st Dec., 1	5/2½ 899)	Used throughout	230
....	Belt	—	B.I.W., lead covd.	—	17 arc, 3 32 c.p. incand.	—	—	—	—	18 arcs	Gas	—	—	—	—	
kw.,	Belt	—	Overhead.....	20 arcs, 1,000 8 c.p.	—	295	6d.	Flat rate	Hookham, Ferranti, and Bastian	36	Gas	£2,500		8/-	—	110
kw., 500	Direct ..	Condensing....	H.P. feeders, conc. cables; L.P. feeders, lead covered arm'rd cables	124,649 8 c p.	257 arcs and 1,027 incnd. (2 lamp stnds.)	21,756 ..	7d. first hour, 1d. after	Wright's	Ferranti, Thomson, and Hookham	4,210	Welsh coal	—	—	7/6	—	115 230
kw.	Direct ..	Condensing....	Callender triple conc. feeders, 3 core dis., solid, H.P. mains	13,395 8 c p., and 80 kw. Chislehurst	—	5,025....	7d. and 4d.	Maximum demand	Ferranti, Aron, and Hookham	608	Welsh, large	£43,318	£18,955	7/8	All.....	210
, 1	Belt and counter-shafting	Non-condensing	Overhead.....	—	—	—	Lighting 8d., power 6d.	Flat rate	Hookham, Ferranti, and Schattner	68	Coal	—	—	—	None	100
kw.,	Rope and direct	Condensing....	Callender, laid in ground and solid	21,195 8 c.p.	3 arcs, 12 8 c.p.	795	Ltg. 6d , pwr. 3d. to 2d.	Flat rate, etc.	Ferranti, Thomson, and Hookham	960	Slack	£51,056	£15,543	5/6	All.....	220
kw.	Direct ..	Condensing....	V.R. and Call. in pipes and conduits	17,688 8 c.p.	34 arcs, 4 incand.	3,791....	Ltg. 6d. & 3d., pwr. 3d. & 1d.	Brighton	Hookham and Bastian	760	Slack	£45,500	£18,500	5/8	All.....	220 440
....	Direct ..	Non-condensing	Callender triple conc. arm'rd	2 arcs, 2,400 8 c.p.	8 arcs, 18 16 c.p.	—	Ltg. 6d., pwr. 3d.	Flat rate	Thomson and Ferranti	132	Pea nuts & cobbles mixed	£17,000	£3,500	—	All.....	200
...	Direct ..	Condensing....	Triple conc. lead covd. and arm'rd	7,000 8 c.p.	25 open arcs	—	Ltg. 6d., 4d., 3d., pwr. 3d.	Sliding scale	Hookham.....	200	Hard steam coal	£25,000		—	—	230
...	Direct ..	Korting ejector condensers	Triple concentric laid direct	9,790 8 c.p.	12 arcs, 268 incand.	—	6d., or M.D. 7d. and 3d.	Optional	Ferranti, Hookh'm, Long-Schttnr. (ppmt.)	300	Coal	—	—	—	—	220
kw.,	Direct ..	Ledward ejector condensers	Cllncer. tpl. con., lead covd. laid direct and solid	12,012 8 c.p	48 arcs	10,426 ..	—	Meter ..	Ferranti and Hookham	370	Coal dust..	£30,000 (about)	—	—	All.....	230
w.	Direct ..	Condensing....	Callender bitumen cables ..	31,064 8 c.p.	159 arcs, 547 8 c p.	5,278, exc. str. ltg.	Ltg. 4½d., pwr. 2½d. to 1½d.	Flat rate and scale	Ferranti and Hookham	990	Gas coke & N.W. slack.	£28,400	£25,313, exc. str. lamps	5/9	All.....	210
rans.	—	—	Callender triple conc. fdrs., 3 core dis., solid, H.P. mains	4,987.....	—	970	8d. and 4d.	Wright's max. de-mand	Aron and Hookham	80	—	£6,508	£10,000	7/5	All.....	210
kw.	Direct coupled	Surface condnsr.	Jute & lead covd., fdrs. Doulton cond., dis. arm'd in grnd.	9,798 8 c.p.	—	5,301....	Ltg. 8d. and 5d., pwr. 4d.	Maximum demand	Hookham.....	400	Round Not. steam coal	£21,444	—	—	169	105
kw.	Direct ..	Condensing....	Callender and B.I.W. arm'd solid	23,200	70 6 amp., 10 55 amp. arcs	6,474, inc. motors	5d. and 1d.	Wright's	Thomson	—	Coal	—	—	—	All.....	230 460
kw.	Direct coupled	Ledward's ejector condensing	Henley single cables solid, in wood troughs	17 enc. arcs, 5,000 8 c p.	35 amp. enc., = 2,000 8 c.p.	—	Ltg. 6d. and 3d., pwr. 3d.	Brighton, Reason D.I.	Thomson.....	520	Slack	£26 800	£6,900	—	—	230
kw.	Direct coupled	Non-condensing	Callender triple conc., arm'd	4,000 8 c p.	40 arcs, 10 in series	—	Lighting 5d., power 2d.	Sliding scale	Hookham and Aron	260	Single nuts	£26,000	£7,000	—	—	230
kw.	Direct ..	Condensing plant on order	B.I.W. arm'rd, laid in ground	8,000 8 c.p.	18 arcs, 150 25 c.p.	3,800....	Ltg. 4½d., pwr. & heat 3d.	—	Bastian, Ferranti, and Hookham	600	Refuse and slack	£30,000	£7,500	—	All.....	230
kw., kw.	Direct ..	Non-condensing	Armoured, lead covrd. in ground	15,000 8 c.p.	32 enc. arcs, 32 incand.	3,000....	Ltg. 6d. & 3½d., pwr. 4d. & 1d.	Brighton	Ferranti, Hookh'm, and Thomson	500	Coal	£25,323		6/8	All.....	220
kw.	Direct ..	Non-condensing (at present)	Callender bit. fibre fdrs, solid, dist. arm'd, laid direct	8,487 8 c.p., exc. motors	2 50 c.p. ..	1st year incomplt.	Lighting 5d., pwr. 3d. and 2½d.	Flat rate	Ferranti, Hookh'm, and Aron	468	Eng. slack, pea nuts, smudge	About £30,000	—	—	—	230 460
kw.	Direct ..	Condensing....	Callender bit. fibre triple conc., in stoneware troughing	—	18 arcs	—	5d.; or 6d. two hrs., and 1½d. after	Wilson time switch	Aron.....	700	Local slack	£35,000	£8,000	—	—	230 v.
120 500	Direct ..	Condensing....	Copr. strip & rub., Callender lead cov. in Doulton con., B.I.W. paper laid solid	45,447	61 arcs ..	7,268....	4d., over 10,000 3d., pwr. 2d., traction 1½d.	Flat rate & rebate	Ferranti and Hookham	1,531	Wallsend & Fife dross	£52,274	£16,688	6/2	All conns. since 1896 200 v.	200
...	Direct ..	Non-condensing	Armoured cable and bare copper strip	283,886 8 c.p.	747 arcs ..	69,848 ..	Lighting 3½d., power 1½d.	Reb. 25 % light only	—	8,137	W. of Scot. wshd. dbls.	—	—	4/3½	230 v. almost entirely	230
...	Direct coupled	Non-condensing	Western Electric paper ins. lead cov., arm'd, laid direct	9 arcs, 4,000 incand.	12 arcs, 500 incand.	All.....	Lighting 6d., power 3d.	Flat rate	Bastian and Johnson-Phillips	120	Town refuse and coal	£15,000	£7,000	—	—	200
., 2 320 ng	Direct ..	Non-condensing	Callender feeders conc., distributors 3 core	About 16,357 8 c.p.	66 arcs & 2 incd. each	6,357....	Lighting 7d., power 1d.	Wright's	Aron and Ferranti	—	Welsh coal	—	—	—	All	210

view" List of Electricity Works o

DIRECT CURREN

e of Engines.	Type of Generators.	Size of Generators.	System of Driving.	Condensing or Non-condensing.	Type of Mains.	Number of Arcs and equiv. 8 C.P. Incandescents used in Private Lighting.	Number of Lamps used in Street Lighting, Arc and Incandescent.	Number of 8 C.P. Lamps added during past 12 months.	Price Charged to Private Consumers.	System of Charging.	Type of Meters Employed on Consumers' Premises.	Present actual Capacity of Works in kw.	
n.p., 2 200 h.p., 0 h.p., Willans; ss	E.C.C., Holmes, Crompton, Bruce Peebles, Mather-Platt, Westinghouse	2 23 kw., 3 48 kw., 2 120 kw., 2 180 kw. 1 390 kw., 1 420 kw.	Direct ..	Non-condensing	Bare copper, Callender, B.I.W., and Siemens	56,825 8 c.p.	204 10 amp. arcs, 180 incand.	13,654 ..	Ltg. 6d. & 3d., pwr. 3d. & 1d	Brighton, M.D. system	Ferranti and Thomson	1,600	
.....	Ediswan 2 pole under type..	46 kw.	Direct ..	Non-condensing	Callender, ld. covd. and armd. fdrs. triple conc., dis. 3-core	2,600.....	—	1,400....	7d. & 4d., and 6d. prepmnt.	Brighton & prepayment	Hookham, Reason, Long-Schattner	92	
00 h.p., Browett-	3 P. R. Jackson's, with Sayers winding	300 kw. each	Direct ..	Condensing plant erecting	Conc. B.I.W., lead covd., in Doulton pipes	71 arcs, 8,150 8 c.p.	72 arcs, 150 incand.	1,845....	Lighting 4½d., power 3d.	Flat rate	Hookham	900	
ns	Fowler.....	2 60 kw.	Direct ..	Non-condensing	B.I.W. paper, triple conc. ..	5,500 8 c.p.	—	Commenced Oct., 1900	5d.	Flat rate	Bastian, Ferranti, Schattner (prept.)	120	
h.p., Willans; 1 tt-Lindley rsal ; 1 250 h.p.,	Johnson-Phillips	3 75 kw., 1 150 kw., 1 100 kw.	Direct ..	Non-condensing at present	B.I.W. solid, and 3 core armd. direct	—	30 arcs, 50 incand.	—	Ltg. 7d. & 3d., power 1½d.	Brighton	Hookham and Reason indctr.	475	
	3 Universal, 1 Bruce Peebles	3 75 k.w., 1 150 kw.	Direct ..	Condensing plant erecting	B.I.W. conc.	15,055 8 c.p. equiv., inc. motors	22 10 amp. arcs, 44 16 c.p. incan.	5,778	Ltg. 6d. & 3d., pwr. 3d. and 1½d.	Brighton	Ferranti and Hookham	375	
p., gas engines;) h.p., 4 700 h.p.,	2 pole under type; 6 2 pole, 4 multi-polar	2 26 kw., 4 57 kw., 2 200 kw., 4 50 kw., 4 500 kw.	Rope and direct*	Condensing....	Bitumen cable in stoneware casing, c.i. pipes & solid	75,000 8 c.p.	—	23,000 ..	Ltg. 6d. & 2d., pwr. 3d. & 1½d.	Wright's	Hookham and Ferranti	2,850	
.....	Allen	2 100 kw.....	Direct ..	Non-condensing	B.I.W. triple conc., lead covd. and arm'rd	7,310 8 c.p.	26 arcs, 332 32 c.p.	9,015....	7d. and 3d.	Wright's	Hookham and Reason (prept.)	200	
).	Brush, Paterson and Cooper, and E.C.C.	1 12 kw., 1 15 kw., 1 18 kw.	Rope....	Non-condensing	Armoured	—	16 arcs	120	—	—	—	45	
h.p., 1 360 i.h.p.,	Crompton, Siemens, and Mavor-Coulson	3 50 kw., 2 150 kw., 1 225 kw.	Direct ..	Non-condensing	Callender and B.I.W.	100 arcs, 19,192 8 c.p.	14 arcs, 10 incand.	4,890....	Ltg. 6d. to 1½d., power 4d. to 1½d.	Discounts	Ferranti and Hookham	675	
ss	Crompton, E.C.C., & Mather-Platt	—	Direct ..	Non-condensing and condensing	Callender, in c.i. conduits ..	150,944 8 c.p. lamps	None.....	—	7d.	Sliding scale	Hookham and Ferranti	—	
h.p., 2 200 h.p., ans; 2 250 h.p.,) h.p., Belliss	Siemens, Mather-Platt, and E.C.C.	2 45 kw., 2 120 kw., 2 150 kw., 1 225 kw., 1 500 kw. con.; 2 60 kw., 1 200 kw. alternating	Direct ..	Part condensing	L.T. rub. in c.i. conduits, alterng. feed. conc. arm'rd	22,793	76 arcs, 239 incand.	—	Ltg. 6d. & 3d., power 2½d. & 1½d.	Brighton	Hookham, Ferranti, and Thomson	1,675	
) h.p., Musgrave	Mather-Platt 12 pole	2 600 kw., 2 300 kw.	Direct ..	Both.....	Triple concentric paper, B.I.W.	—	—	—	—	—	Ferranti	1,800	
h.p , Belliss....	Parker.....	2 75 kw., 3 150 kw.	Direct ..	Condensing....	B.I.W.....	8,588 8 c p.	80 arcs, 160 incand.	—	Ltg. 5d. & 3d., pr. 5d. & 1½d.	Wright's	Hookham	—	
all; 2 150 h p.,) h.p., 2 340 h.p.,) h.p., Willans	Siemens and E.C.C.....	1 85 kw., 2 82 kw., 2 125 kw., 2 175 kw., 2 210 kw., 2 375 kw., 5 380 kw.	Direct ..	Condensing....	B.I.W., armoured and lead covered cables, laid in ground	172,741 8 c.p. (inc. 805 arcs)	51 arcs (12 with 2 50 c.p.)	In. 12,360, arcs 1,290, mts. 26,458	Ltg. 4½d., 2½ % dis. and free lmps., pwr. & ltg. 2d. intmt.	Flat rate	Thomson, Hkham., Ferranti, Bastian, and Aron	3,569	
2 b.h.p.....	Thomson-Houston series....	18 arc lighter	Belt	—	B.I.W., lead covd.	—	17 arc, 3 32 c.p. incand.	—	—	—	—	18 arcs	
h.p., 1 14 h.p. al	Kapp	1 7 kw., 1 13 kw., 1 16 kw.	Belt	—	Overhead.....	20 arcs, 1,000 8 c.p.	—	295	6d.	Flat rate	Hookham, Ferranti, and Bastian	36	
p., 4 360 h.p., 6 s	6 multi-polar, 8 bi-polar	2 45 kw., 2 120 kw., 4 220 kw., 6 500 kw.	Direct ..	Condensing....	H.P. feeders, conc. cables; L.P. feeders, lead covered arm'rd cables	124,649 8 c p.	257 arcs and 1,027 incnd. (2 lamp stnds.)	21,756 ..	7d. first hour, 1d. after	Wright's	Ferranti, Thomson, and Hookham	4,210	
h.p., Belliss	Parker.....	3 84 kw., 2 180 kw.	Direct ..	Condensing....	Callender triple conc. feeders, 3 core dis., solid, H.P. mains	13,395 8 c p., and 80 kw. Chislehurst	—	5,025....	7d. and 4d.	Maximum demand	Ferranti, Aron, and Hookham	608	
emi-portable, 40	Elwell - Parker, Goolden, Greenwood-Batley	2 9 kw., 1 10 kw., 1 40 kw.	Belt and counter-shafting	Non-condensing	Overhead.....	—	—	—	Lighting 8d., power 6d.	Flat rate	Hookham, Ferranti, and Schattner	68	
h.p. horizontal, al, Belliss	Elwell-Parker and E.C.C. ..	2 90 kw., 1 120 kw., 2 330 k.w.	Rope and direct	Condensing....	Callender, laid in ground and solid	21,195 8 c.p.	3 arcs, 12 8 c.p.	795	Ltg. 6d., pwr. 3d. to 2d.	Flat rate, etc.	Ferranti, Thomson, and Hookham	960	
0 b.h p., Belliss	—	2 130 kw., 2 250 kw.	Direct ..	Condensing....	V.R. and Call. in pipes and conduits	17,688 8 c.p.	34 arcs, 4 incand.	3,791....	Ltg. 6d. & 3d., pwr. 3d. & 1d.	Brighton	Hookham and Bastian	760	
.....	—	60-66 kw.....	Direct ..	Non-condensing	Callender triple conc. arm'rd	2 arcs, 2,400 8 c.p.	8 arcs, 18 16 c.p.	—	Ltg. 6d., pwr. 3d.	Flat rate	Thomson and Ferranti	132	
b.h.p.	Mather-Platt	2 75 kw., 4 12 kw..	Direct ..	Condensing....	Triple conc. lead covd. and arm'rd	7,000 8 c.p.	25 open arcs	—	Ltg. 6d., 4d., 3d., pwr. 3d.	Sliding scale	Hookham.....	200	
0 b.h p.....	India-rubber & Gutta Percha Co.	4 38 kw., 2 75 kw...	Direct ..	Korting ejector condensers	Triple concentric laid direct	9,790 8 c.p.	12 arcs, 268 incand.	—	6d., or M.D. 7d. and 3d.	Optional	Ferranti, Hookh'm, Long-Schttnr. (ppmt.)	300	
200 i.h p., 2 400	6 Siemens, 2 Peebles	4 30 kw., 2 125 kw., 2 250 kw.	Direct ..	Ledward ejector condensers	Cllncer. tpl. con., lead covd. laid direct and solid	12,012 8 c.p	48 arcs	10,426 ..	—	Meter ..	Ferranti and Hookham	870	
h.p., Belliss....	Parker	3 80 kw., 3 250 kw.	Direct ..	Condensing....	Callender bitumen cables ..	31,064 8 c.p.	159 arcs, 547 8 c p.	5,278, exc. str. ltg.	Ltg. 4½d., pwr. 2½d. to 1½d.	Flat rate and scale	Ferranti and Hookham	990	
ntinuous current)	Parker	2 40 kw. motor trans.	—	—	Callender triple conc. fdrs., 3 core dis., solid, H.P. mains	4,987.....	—	970	8d. and 4d.	Wright's max. demand	Aron and Hookham	80	
060 i.h.p., Peache	Siemens	3 60 kw., 1 220 kw.	Direct coupled	Surface condnsr.	Jute & lead covd., fdrs. Doulton cond., dis. arm'd in grnd.	9,798 8 c.p.	—	5,301....	Ltg. 8d. and 5d., pwr. 4d.	Maximum demand	Hookham.....	400	
intosh-Seymour;	Thomson-Houston	3 200 kw., 2 300 kw.	Direct ..	Condensing....	Callender and B.I.W. arm'd solid	23,200	70 6 amp., 10 55 amp. arcs	6,474, inc. motors	5d. and 1d.	Wright's	Thomson	—	
.....	3 Mather-Platt	2 200 kw., 1 120 kw.	Direct coupled	Ledward's ejector condensing	Henley single cables solid, in wood troughs	17 enc. arcs, 5,000 8 c p.	35 amp. enc., = 2,000 8 c.p.	—	Ltg. 6d. and 3d., pwr. 3d.	Brighton, Reason D.I.	Thomson.....	520	
150 h.p., Scott-	Scott-Mountain	4 17 kw., 2 100 kw.	Direct coupled	Non-condensing	Callender triple conc., arm'd	4,000 8 c p.	40 arcs, 10 in series	—	Lighting 5d., power 2d.	Sliding scale	Hookham and Aron	260	
h.p., Belliss	Siemens and Mather-Platt ..	2 150 kw., 1 300 kw.	Direct ..	Condensing plant on order	B.I.W. arm'rd, laid in ground	8,000 8 c.p.	18 arcs, 150 25 c.p.	3,800....	Ltg. 4½d., pwr. & heat 3d.	—	Bastian, Ferranti, and Hookham	600	
) h.p., 1 55 h.p., lans	Crompton and Peebles.....	2 100 kw., 1 50 kw., 1 30 kw., 2 125 kw.	Direct ..	Non-condensing	Armcured, lead covrd. in ground	15,000 8 c.p.	32 enc. arcs, 32 incand.	3,000....	Ltg. 6d. & 3½d., pwr. 4d. & 1d.	Brighton	Ferranti, Hookh'm, and Thomson	500	
) i.h.p., Willans..	Mather-Platt	3 56 kw., 2 150 kw.	Direct ..	Non-condensing (at present)	Callender bit. fibre fdrs, solid, dist arm'd, laid direct	8,487 8 c.p., exc. motors	2 50 c.p. ..	1st year incomplt.	Lighting 5d., pwr. 3d. and 2½d.	Flat rate	Ferranti, Hookh'm, and Aron	468	
50 h.p., Westing-	Westinghouse	3 200 kw., 1 100 kw.	Direct ..	Condensing....	Callender bit. fibre triple conc., in stoneware troughing	—	18 arcs	—	5d.; or 6d. two hrs., and 1½d. after	Wilson time switch	Aron.....	700	
750 h.p. erecting	Siemens and Parker	40 kw., 80 kw., 120 kw., 300 kw.; 500 kw. erecting	Direct ..	Condensing....	Copr. strip & rub., Callender lead cov. in Doulton con., B.I.W. paper laid solid	45,447	61 arcs ..	7,268....	4d., over 10,000 3d., pwr. 2d., traction 1½d.	Flat rate & rebate	Ferranti and Hookham	1,531	
, Willans	Various	60 to 780 kw.	Direct ..	Non-condensing	Armoured cable and bare copper strip	283,886 8 c.p.	747 arcs ..	69,848 ..	Lighting 3½d., power 1½d.	Reb. 25 % light only	—	8,137	
lans.....	Johnson-Phillips	60 kw.	Direct coupled	Non-condensing	Western Electric paper ins. lead cov., arm'd, laid direct	9 arcs, 4,000 incand.	12 arcs, 500 incand.	All.....	Lighting 6d., power 3d.	Flat rate	Bastian and Johnson-Phillips	120	
) h.p. Peache	Parker	2 160 and 460 v., 2 370 and 460 v.; 2 320 kw., 2,500 v. adding	Direct ..	Non-condensing	Callender feeders conc., distributors 3 core	About 16,357 8 c.p.	66 arcs & 2 incd. each	6,357....	Lighting 7d., power 1d.	Wright's	Aron and Ferranti	—	
40 h.p. turbines	Laurence, Scott & Co.	15 kw., 80 kw.	Direct		Overhead and underground	4,500 8 c.p.	6 arcs, 52 in.	500	6½d.	—	—	130	

(38) Edinburgh ..	Corporation	3 wire, D.C. & high press. A.C.	Marine and water tube	100 to 1,200 h.p., Willans		Various		60 to 780 kw.	Direct ..	Non-co
(39) Fleetwood and District	Fleetwood and District Elec. Lt. and Pwr. Synd.	3 wire	2 B. & W...	2 110 i.h.p., Willans.....		Johnson-Phillips		60 kw.	Direct coupled	Non-co
(40) Folkestone	Folkestone Electricity Supply Co., Ltd.	3 wire	Paxman's economic	2 120 h.p., 2 250 h.p.	Peache	Parker		2 160 and 460 v., 2 370 and 460 v.; 2 320 kw. 2,500 v. adding	Direct ..	N

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Meters ed on Premises.	Present actual Capacity of Works in kw.	Nature of Fuel used.	Total Cost of Construct-ing and Equipping Works.	Cost of Mains.	Annual Revenue per 8 C.P. Lamp Installed.	Number of High Voltage Lamps used.	Declared Pressure at Consumers' Terminals.	No. and aggregate H.P. of Motors connected.	Remarks.	Engineer-in-Chief.	PLACE.
											PROVINCIAL.
nd homson	1,600	Coal	£51,115 July,	£42,251 1900	About 4/9	Used exclusively	220 v.	80 = 383 h.p.*	* Exclusive of tramway motors	J. Alex. Bell....	**Aberdeen** .....(1)
Reason, nattner	92	Stafford burgie	£16,074	£8,300	—	—	210 v.	—	——	Herbert W. Watts	**Alderley and Wilmslow** (2)
.....	900	Bolsover slack	—	—	—	—	200 v.	500 h.p.	Combined lighting and traction	N. Appelbee ..	**Ashton-under-Lyne** (3)
erranti, r (prept.)	120	Coke and refuse	—	£6,000	—	All.....	200 v.	—	Extensions to be made..	Price F. White	**Bangor (N. Wales)** (4)
and ndctr.	475	Slack	—	—	—	—	230 v.	15 = 80 h.p. ..	300 kw. Willans Peebles set on order	G. E. Bastow..	**Barnsley** .....(5)
nd ookham	375	Yorkshire nuts	£32,500 (approx.)	£7,000 (approx.)	7/- (apprx.)	All.....	220 v.	29 = 150 e.h.p.	Extensions in progress..	H. R. Burnett..	**Barrow-in-Furness** (6)
and Ferranti	2,850	Engl'h slack and nuts	—	—	5/1 in '99 4/- in '00	All.....	220 v.	490 h.p.	* Gas plant rope driven. Motors let out on hire	Victor A. H. McCowen	**Belfast** .....(7)
and prept.)	200	Best Welsh	£24,000	£10,000	—	—	220 v.	8 = 26 h.p.	Con. plant to be erected, 1 150 kw. set and 1 B. & W. boiler on order	W. T. LeFeuvre	**Bexhill**..... (8)
	45	Coal	£3,000	£200	—	None	—	1	——	C. L. N. Wilson	**Bilston** .....(9)
nd ookham	675	Slack	—	—	—	All.....	230 v	12 = 32 h.p. ..	——	William Bates	**Birkenhead** ....(10)
and Ferranti	—	—	—	—	—	—	—	235 = 646 h.p.	——	J. C. Vaudrey..	**Birmingham**... (11)
and	1,675	Slack	£51,553	£29,882	5/10	Used on outskirts of L.T. area	110 v. and 220 v.; 500 v. to tramway dept.	538 h.p.	Changing over pressure to 220 v., 440 v.	A. S. Giles	**Blackburn** † ‡.. (12)
.....	1,800	Slack	£45,000	£5,000 (feeders)	—	—	230 v.	—	——	A. Ellis	**Bolton** † ‡ ..... (13)
.....	—	Slack	—	—	—	—	220 v.	6 = 20½ h.p. ..	——	W. R. Wright..	**Bootle** .....(14)
Hkham., Bastian,	3,569	Yorkshire nuts, coal	£202,703 (31	£79,564 st Dec., 1	5/2½ 899)	Used throughout	230 v.	609 = 2,622 h.p.	2 stations. Current supplied for both lighting and traction	R. A. Chattock	**Bradford** .....(15)
	18 arcs	Gas	—	—	—	—	—	—	——	A. Sharp	**Bridlington** ....(16)
Ferranti, an	36	Gas	£2,	500	8/-	—	110 v.	6 = 15 h.p.....	——	A. Aspinall	**Brighouse** .....(17)
homson, ham	4,210	Welsh coal	— .	—	7/6	—	115 v. and 230 v.	Abt. 150 motors	John Christie, res. eng. and man.	Arthur Wright, cons. eng.	**Brighton** ‡ .....(18)
ron, and	608	Welsh, large	£43,318	£18,955	7/8	All.....	210 v.	90 kw.	——	R. L. Gamlen..	**Bromley (Kent)** (19)
and	68	Coal	—	—	—	None	100 v.	—	——	Messrs. Gillies and Hornidge	**Buckingham** ..(20)
homson, ham	960	Slack	£51,056	£15,543	5/6	All.....	220 v.	40 h.p.	Data to March 31st, 1900	R. Birkett	**Burnley** .....(21)
and Bastian	760	Slack	£45,500	£18,500	5/8	All.....	220 v. and 440 v.	25 = 85 h.p. ..	——	S. J. Watson ..	**Bury** .....(22)
nd Ferranti	132	Pea nuts & cobbles mixed	£17,000	£3,500	—	All.....	200 v.	1 = ¼ h.p.	Started August, 1900 ..	Arthur H. Roe	**Bury St. Edmunds** (23)
.....	200	Hard steam coal	£25,	000	—	—	230 v.	2 = 5 h.p.	Commenced supply May, 1900. 600 h.p. on order and 2 boilers	Edward Calvert	**Buxton** .....(24)
ookh'm, ttnr.	300	Coal	—	—	—	—	220 v.	5 = 120 h.p. abt.	——	Norman Staniland	**Canterbury** ....(25)
nd ookham	870	Coal dust..	£30,000 (about)	—	—	All.....	230 v.	46 = 159¼ h.p.	——	Chas. D. Burnet	**Carlisle** .....(26)
nd ookham	990	Gas coke & N.W. slack.	£28,400	£25,313, exc. str. lamps	5/9	All.....	210 v.	44 = 104 h.p...	——	F. Thursfield ..	**Chester** .....(27)
ookham	80	—	£6,508	£10,000	7/5	All.....	210 v.	None.....	——	F. S. Hanning..	**Chislehurst** ....(28)
.....	400	Round Not. steam coal	£21,444	—	—	169	105 v.	8 = 49 h.p.....	——	Alfred R. Sillar	**Colchester**.....(29)
.....	—	Coal	—	—	—	All.....	230 v. and 460 v.	510 h.p., not including traction	——	C. H. Merz ..	**Cork**.....(30)
.....	520	Slack	£26 800	£6,900	—	—	230 v.	1 = 5 h.p.	Commenced supply Dec. 17th, 1900. Extensions in hand, £8,900	H. H. Denton..	**Crewe** .....(31)
nd Aron	260	Single nuts	£26,000	£7,000	—	—	230 v.	—	——	J. R. P. Lunn..	**Darlington** ....(32)
erranti, ham	600	Refuse and slack	£30,000	£7,500	—	All.....	230 v.	23 = 23 h.p. ..	Coal fired boiler and Belliss, Peebles 500 h.p. on order for traction exten.	—	**Darwen** .....(33)
ookh'm, nson	500	Coal	£25,	323	6/8	All.....	220 v.	17 = 50 h.p. ..	——	O. M. Jonas....	**Dewsbury** .....(34)
ookh'm,	468	Eng. slack, pea nuts, smudge	About £30,000	—	—	—	230 v. and 460 v.	20 b.h.p.	Combined lighting and traction station	C. A. L. Prusmann	**Doncaster**.....(35)
.....	700	Local slack	£35,000	£8,000	—	—	230 v. or 460 v.	—	Combined lighting and traction station	R.P. Wilson (con.) J. A. Marsh (res.)	**Dudley** .....(36)
nd ookham	1,531	Wallsend & Fife dross	£52,274	£16,688	6/2	All conns. since 1896 200 v.	200 v.	64, exc. traction	——	Walter H. Tittensor	**Dundee** .....(37)
	8,137	W. of Scot. wshd. dbls.	—	—	4/3½	230 v. almost entirely	230 v.	451 = 1,434½ h.p.	Data refer to year ending 15th May, 1900	Frank A. Newington	**Edinburgh** ‡ ....(38)
d John-ps	120	Town refuse and coal	£15,000	£7,000	—	—	200 v.	5 = 20 h.p.....	600 ampere-hour chloride battery	'Osborn Hansom	**Fleetwood and District** (39)
erranti	—	Welsh coal	—	—	—	All	210 v.	9 = 22½ h.p.	——	Thos. Hesketh	**Folkestone** ....(40)
	180	—	£9,	500	—	150 volt lamps	150 v.	4 h.p.	——	Irvine Reid....	**Fort William** †..(41)

Direct ..	Non-condensing	Armoured cable and bare copper strip	283,886 8 c.p.	747 arcs ..	69,848 ..	Lighting 3½d., power 1½d.	Reb. 25 % light only	—	8,137	W. of Scot. wshd. dbls.	—	—	4/3½	230 v. almost entirely
Direct coupled	Non-condensing	Western Electric paper ins. lead cov., arm'd, laid direct	9 arcs, 4,000 incand.	12 arcs, 500 incand.	All.....	Lighting 6d., power 3d.	Flat rate	Bastian and Johnson-Phillips	120	Town refuse and coal	£15,000	£7,000	—	—
v., 2 320 ding	Direct ..	Non-condensing	Callender feeders conc., distributors 3 core	About 16,357 8 c.p.	66 arcs & 2 incd. each	6,357....	Lighting 7d., power 1d.	Wright's	Aron and Ferranti	—	Welsh coal	—	—	—	All .....

(38) Edinburgh ‡ ..	Corporation	3 wire, D.C. & high press. A.C.	Marine and water tube	100 to 1,200 h.p., Willans	Various	60 to 780 kw.	Direct ..	Non-c
(39) Fleetwood and District	Fleetwood and District Elec. Lt. and Pwr. Synd.	3 wire	2 B. & W...	2 110 i.h.p., Willans, ...	Johnson-Phillips	60 kw.	Direct coupled	Non-c
(40) Folkestone	Folkestone Electricity Supply Co., Ltd.	3 wire	Paxman's economic	2 120 h.p., 2 250 h.p. Peache	Parker	2 160 and 460 v., 2 370 and 460 v.; 2 320 kw., 2,500 v. adding	Direct ..	Non-c
(41) Fort William †..	Fort William Electric Light Co.	3 wire	—	2 60 h.p. each, 1 40 h.p., turbines, Gilkes	Laurence, Scott & Co., General Electric	45 kw., 30 kw.....	Direct ..	
(42) Galway	Galway Electric Light Co., Ltd.	2 wire	Dowson gas producer	2 75 h.p. Hercules turbines; 1 32 b.h.p. gas engine	Statter and Crompton	Largest 32 kw., smallest 4 kw.	Belts....	No s gine
(43) Glasgow	Corporation	3 wire	Marine and B. & W.	2 80 h.p., 2 150 h.p. 3 250 h.p., 6 350 h.p., 2 1,100 h.p., Willans; 2 1,100 h.p., 2 400 h.p., Belliss; 2 200 h.p., Alley-MacLellan; 1 900 h.p., Paul; 1 700 h.p., Ball-Wood; 2 400 h.p., Mirrlees-Watson	13 Siemens, 6 Crompton, 2 British Thomson-Houston, 2 Walker, 2 Mavor-Coulson, 1 Schuckert	2 48 kw., 2 90 kw., 3 160 kw., 6 240 kw., 4 750 kw., 2 260 kw., 2 130 kw.	All coupled direct	Wate work dens Dun dens
(44) Gloucester	Corporation	3 wire	4 Lancs. ..	1 250 h.p., 1 500 h.p., Belliss; 1 500 h.p., Willans	4 Silvertown, 2 Mather-Platt	2 75 kw., 4 150 kw.	Direct ..	Conde
(45) Gorseinon	Electric Light Co.....	2 wire	Vertical ..	1 12 h.p. steam engine	Elwell-Parker	22 kw.	Belt	
(46) Govan	Corporation	3 wire	B. & W. ..	2 150 h.p., 1 324 h.p, Belliss	2 British Thomson-Houston, 1 Silvertown	2 95 kw., 1 200 kw.	Direct coupled	Non-c
(47) Great Crosby & Waterloo with Seaforth	Liverpool District Lighting Co., Ltd.	2 wire	Lancs.	2 Browett-Lindley, 1 Willans....	1 Robinson, 1 Siemens, and 3 Parker	2 43 kw., 3 86 kw...	Direct ..	Non-c
(48) Great Grimsby	Corporation	3 wire	4 Lancs. ..	2 75 i.h.p., 4 150 i.h.p., 1 350 i.h.p., Belliss	——	4 22 kw., 4 93 kw., 1 220 kw.	Direct ..	Conde
(49) Greenock.....	Police Board	3 wire	2 B. & W...	1 160 i.h.p., 2 250 i.h.p., Belliss ..	Silvertown, 2 shunt, 300 v., 2 compound, 600 v.	2 50 kw. (300 v.) 2 150 kw. (600 v.)	Direct coupled	Non-c
(50) Guernsey	Guernsey Electricity Supply Co.	3 wire	3 B. & W...	2 100 i.h.p., 1 200 i.h.p., Belliss..	Parker	2 75 kw., 1 150 kw.	Direct ..	Non-c
(51) Guildford†	Guildford Electricity Supply Co.	3 wire 400 v.	—	3 40 i.h.p., 1 100 i.h.p.	——	3 20 kw., 1 60 kw. ..	Direct ..	
(52) Harrow-on-the-Hill	Harrow Electric Light and Power Co., Ltd.	3 wire	B. & W. water tube	Willans	Crompton and Mather-Platt	3 60 kw., 1 23 kw., 1 150 kw.	Direct ..	Non-c
(53) Hereford	Town Council	3 wire	2 Lanc (Meldrum's fcd draught)	2 150 i.h.p, Belliss 1 375 i.h.p., Belliss on order	India-rubber & Gutta Percha Co.	200 amps., 500 volts each; 2 100 kw., 1 250 kw. on order	Direct ..	Conde
(54) High Wycombe	W. (Boro) Electric Light and Power Co., Ltd.	3 wire	4 Davey-Paxman economic	2 150 h.p. each, 2 250 h.p., Peache	Parker	2 72 kw., 2 150 kw.	Direct coupled	Non-c
(55) Hove	Hove Electric Light Co.	3 wire	2 Lancs., 4 water tube	3 100 h.p., 3 250 h.p., 2 360 h.p., 1 38 h.p., Willans; 1 150 h.p., Belliss	Crompton	3 60 kw., 3 154 kw., 1 90 kw., 2 222 kw., 1 23 kw.	Direct ..	Non-c
(56) Hull.....	Corporation	H.P. con. with trans. & aux. L.T. plnt.	4 mar. Drybk., 8 Lancs., 1 water tube	2 80 h.p., 2 200 h.p., 2 300 h.p., 2 400 h.p., 2 360 h.p., Willans; 4 800 h.p., 1 200 h.p., Allen	4 Siemens, 110 v.; 2 Holmes, 220 v.; 2 Parker, 220 v., 6 do., 2,250 v., 1 do. 440 v.	2 44 kw., 3 115 kw., 2 180 kw., 2 45 kw. 2 202 kw., 4 520 kw.	Direct ..	Conde
(57) Ingleton	Ingleton Elec. Light and Power Company, Ltd.	3 wire	—	2 vortex turbines, 16 to 20 h.p., Gilkes	Hall	35 to 45 amps., 330 to 250 v.	Belts....	
(58) Keynsham † ..	Keynsham Electric Light and Power Co., Ltd.	Series for streets, parallel	2 48 i.h.p. economic	2 12 nom. h.p. (Davey-Paxman) indicating 36 i h.p	Johnson-Phillips and Taunton	2 9·5 units, 1 24 units	Belt	Non-c
(59) King's Lynn ..	Corporation	3 wire	4 Dowson gas prods.	5 65 b.h.p., gas, Fielding and Platt; 1 175 b.h.p, steam	General Electric Co.	5 40 kw. and 1 120 kw.	Belts and direct	Steam cond
(60) Lancaster	Corporation	3 wire	3 Lancs. ..	1 350 h.p., 1 200 h.p., 1 135 h.p., 1 60 h.p. Willans	3 Brush, 1 Mather-Platt....	1 120 kw., 1 80 kw., 1 36 kw., 1 180 kw.	Direct ..	Conde
(61) Leamington ..	Midland Electric Light and Power Co., Ltd.	2 wire	3 Robey loco.	2 250 h.p., 1 30 h.p.....	Chamberlain-Hookham	4 80 kw., 1 30 kw...	Ropes and belts	Conde
(62) Leigh	Corporation	3 wire	2 Lancs. ..	2 135 h.p., Willans	Mather-Platt	2 80 kw.	Direct ..	Non-c at pr
(63) Leith	Town Council.....	3 wire	3 Lancs. ..	4 150 h.p., 1 100 h.p., 1 300 h.p., Belliss	Silvertown	4 92 kw., 1 60 kw., 1 212 k.w.	Direct ..	Non-c
(64) Leyton	District Council.....	3 wire	5 gas getrs., 4 Paxman econ. blrs.	4 60 b.h.p. gas engines, 4 85 b.h.p., Wells; 4 350 i.h.p, Willans	Fuller-Wenström, E.C.C., General Electric Co., and Mather-Platt	4 35 kw., 4 52 kw., 4 227 kw.	Belts and direct	Non-c
(65) Lincoln	Corporation	3 wire	5 marine ..	3 80 i.h.p., 3 320 i.h.p., Willans..	Laurence, Scott & Co	3 66 kw., 2 200 kw.	Direct coupled	Ejecto sers
(66) Liverpool	Corporation	2 and 3 wire	Lancs.	300 h.p. and 1,200 h.p., Willans	Siemens and E.C.C.	160 kw. and 600 kw.	Direct ..	Conde non-c
(67) Llandudno	Urban District Council	3 wire	4 B. & W. (2 in dest.)	2 150 h.p., 1 75 h.p., 1 240 h.p., Belliss	Silvertown	2 100 kw., 1 50 kw., 1 150 kw.	Direct ..	Ledwa orativ
(68) Londonderry ..	Corporation	Series	Penmans' Lancs.	3 compound cond., 150 h.p.	Siemens	6 30 kw.	Belt	Conde
(69) Lymington	Lymington Electric Light and Power Co.	3 wire	2 B. & W...	2 100 b.h.p., Belliss	Parker	62 kw.	Direct ..	Non-c
(70) Maerdy	Maerdy Electric Light Co., Ltd.	2 wire	1 loco. type	1 56 b.h.p., Robey.....	Crompton	39 kw.	Belt	Non-c
(71) Manchester	Corporation	5 wire and 3 wire	18 Lancs. 4 B. & W.	11 400 h.p., 2 2,500 h.p. 2 1,000 h.p.	11 bi-polar, 4 multi-polar ..	11 250 kw., 2 1,500 kw., 2 750 kw.	Belts and direct	Conde
(72) Melton Mowbray	Melton Mowbray Electric Light Co.	3 wire	B. & W. ..	150 h.p., Parsons turbines	——	75 kw.	Direct coupled	Conde (K
(73) Mevagissey	Mevagissey Electric Lighting Co., Ltd.	2 wire	Loco.	Semi-portable 30 h.p.	Crompton	26 kw.	Belt	Non-c
(74) Middlesbro'	Corporation	3 wire	3 Lancs. ..	1 200 i.h.p., Browett-Lindley; 1 550 i.h.p., Davy Brothers	P. R. Jackson & Co., Sayer's winding	2 55 kw., 1 300 kw...	Direct ..	Korting conde
(75) Middleton.....	Middleton Electric Light and Power Co.	—	Lancs.	1 20 h.p.	2 Wilson	—	Belt	Non-c
(76) Morecambe	Urban District Council	High pressure	B & W. and Lancs.	3 125 i.h.p., 2 15 i.h.p., Peache; 1 300 h.p. turbine, Parsons	Parker and Parsons	3 90 kw., 1 200 kw., 2 10 kw.	Direct coupled	Conden
(77) Motherwell	Burgh Councillors.....	3 wire	2 Lancs. ..	2 100 h.p., 2 40 h.p., Willans	Mavor-Coulson	2 80 kw., 2 20 kw. ..	Direct ..	Non-c
(78) Nelson	Corporation	2 wire	2	Willans	Seimens and Holmes	77 kw.	Direct ..	
(79) Newmarket ..	Newmarket Elec. Light Co., Ltd.	3 wire	2 Davey-Paxman loco.	2 100 h.p., Willans; 1 200 h.p., Allen	Parker	2 55 kw.	Direct coupled	Non-c
(80) Northallerton..	Northallerton Electric Light and Power Co.	2 wire	1 Economic, 2 Robey loco.	1 100 h.p., Alley-MacLellan; 2 30 h.p., Robey	1 G.E.C., 2 Crompton	1 74 kw., 2 24 kw. ..	Direct and belt	Non-c
(81) Northampton †	Northampton Electric Light and Power Co.	3 wire	3 Lancs., 2 B. & W...	3 120 h.p., Scott; 1 60 h.p., 2 240 h.p., Willans; 1 40 h.p., Belliss	Crompton and 1 E.C.C.	2 64 kw., 1 68 kw., 1 25 kw., 1 44 kw., 2 120 kw.	Direct and ropes	Non-c
(82) Northwich	Northwich Electricity Supply Co., Ltd.	3 wire	—	3 100 b.h.p., 1 20 b.h.p. gas engns., Crossley	Laurence, Scott & Co.	3 60 kw., 2 7 kw., gas-driven boosters	Belting..	—
(83) Norwich	Norwich Electricity Supply Co.	3 wire	Babcock ..	3 100 i.h.p., 3 135 i.h.p., 2 200 i.h.p., 3 300 i.h.p., 1 700 i.h.p., Willans	Norwich	6 30 kw., 3 81 kw., 2 125 kw., 3 187 kw., 1 440 kw.	Direct ..	Körting ser to gine
(84) Nottingham ..	Corporation	3 wire	8 Lancs., 7 Dryback	3 80 h.p., 7 134 h.p., 4 360 h.p., 4 700 h.p., Willans	Siemens	—	Direct ..	—
(85) Ogmore Valley†	Ogmore Valley Electric Light and Power Co.	2 wire	Loco. type tubular	2 35 h.p. undertype	J. C. Howell	1 200 amps., 1 300 amps., 5 70 amps.	Belt	Non-con
(86) Oldham	Corporation	2 and 3 wire	8 Lancs. ..	2 60 h.p., 2 100 h.p., 2 200 h.p., 4 360 h.p., Willans	Charlesworth Hall and Siemens	2 36 kw., 2 60 kw., 2 120 kw., 4 225 kw.	Direct ..	Condens
(87) Oswestry	Oswestry Electric Light and Power Co.	2 wire	1 B. & W., 2 loco.	2 Marshall, 1 Belliss, 1 Scott-Mountain	2 Parker, 1 Siemens, 1 Scott-Mountain	2 30 kw., 1 33 kw., 1 80 kw.	Ropes and direct	Non-con
(88) Oxford	Oxford Electric Light Co	Sub-station,	5 loco., 1 economic	3 vertical 150 h.p., 1 do. 200 h.p., 1 do. 600 h.p.; 1 450 h.p., Willans	E.C.C., 1,000 v.	3 90 kw., 1 100 kw., 1 260 kw., 1 225 kw.	Ropes, belt and	Condens

....	Various	60 to 780 kw.	Direct ..	Non-condensing	Armoured cable and copper strip	bare	283,8868 c.p.	747 arcs ..	69,848 ..	Lighting 3½d., power 1½d.	Reb. 25 % light only	—	8,487	W. c wsh
....	Johnson-Phillips	60 kw.	Direct coupled	Non-condensing	Western Electric paper ins. lead cov., arm'd, laid direct		9 arcs, 4,000 incand.	12 arcs, 500 incand.	All.....	Lighting 6d., power 3d.	Flat rate	Bastian and Johnson-Phillips	120	Towy and
....	Parker	2 160 and 460 v., 2	Direct ..	Non-condensing	Callender feeders conc., distri-		About	66 arcs & 2	6,357....	Lighting 7d.,	Wright's	Aron and Ferranti	—	

Direct ..	Non-condensing	Armoured cable and bare copper strip	283,886 8 c.p.	747 arcs ..	69,848 ..	Lighting 3½d., power 1½d.	Reb. 25 % light only	—	8,137	W. of Scot. wshd. dbls.	—	—	4/3½	230 v. almost entirely	230 v. ..
Direct coupled	Non-condensing	Western Electric paper ins. lead cov., arm'd, laid direct	9 arcs, 4,000 incand.	12 arcs, 500 incand.	All.....	Lighting 6d., power 3d.	Flat rate	Bastian and Johnson-Phillips	120	Town refuse and coal	£15,000	£7,000	—	—	200 v. ..
Direct ..	Non-condensing	Callender feeders conc., distributors 3 core	About 16,357 8 c.p.	66 arcs & 2 incd. each	6,357....	Lighting 7d., power 1d.	Wright's	Aron and Ferranti	—	Welsh coal	—	—	—	All	210 v. ..
Direct ..	—	Overhead and underground..	4,500 8 c.p.	6 arcs, 52 incand.	500	6½d.	—	—	130	—	£9,500		—	150 volt lamps throughout	150 v. ..
Belts....	No steam engines used	Bare cop. tbs. in stn. p., arm. bit. cab., ld. cov. diatrn. in bitu.	7 arcs, 3,077 8 c.p.	7 arcs, 4 incand.	About 400	Lighting 5d., power 3d.	Contract and meter	Hookham, Thomson, and Aron	83·5	Coke, anth. coal	£8,000	£2,100	8/-	None	110 v. ..
All coupled direct	Waterloo Street works non-condensing; Port Dundas condensing	Bare strip, rubber cables i.p., arm'd lead covered jute and B I.W. paper cables, separate and concentric in iron and wood troughs	291,665 8 c.p., Dec. 31st, 1900	265 arcs ..	—	6d. first hr., after, 2½d. 100 v., 2d. 200 v., 1½d. 250 v.; over 8 hrs. no 6d. units	Maximum demand & fixed rate	Ferranti, Hookham, and Bastian	6,402	Coal	£609,000, includ. mains	£316,000	6/3	100 v., 200 v., 250 v.	250 v. ..
Direct ..	Condensing....	Callender cables, solid.....	13,400 8 c.p	52 10 amp. arcs	13,400 ..	Ltg. 7d. & 2d., pwr. 4½d. & 1½d.	Maximum demand	Hookham	750	Slack	£55,000	£16,000	—	All.....	220 v. a 440 v.
Belt	—	Overhead.....	570 8 c.p...	—	30	1/3 per candle per annum	Contract	—	22	Bituminous coal	£1,000	£200	10/-	—	100 v. ..
Direct coupled	Non-condensing	Callender lead covd. arm'rd cables laid direct	12,000 8 c.p.	85 10 amp. arcs	9,000....	6d. 1st hr., 2d. after	Maximum demand	Ferranti and dem. indicators	390	Scotch coal, dross	£26,000		—	—	250 v. ..
Direct ..	Non-condensing	Callender, solid	8 arcs, 11,842 inc.	16 arcs	3,622....	6d.	Flat rate	Hookham	348	Best Lancs. slack	£14,951	£16,764	—	—	220 v. ..
Direct ..	Condensing....	B.I.W., solid	—	60 arcs	—	5d.	Flat rate	Hookham	670	—	Estimd. £55,000	—	—	—	230 v. ..
Direct coupled	Non-condensing	Callender solid and Callender-Webber casing, single cables	11,300	44 10 amp. arcs	11,295 ..	5½d. flat; 2d. fxd. ch.; 7d. & 1½d. m.d.; pwr. 2d.	Flat rate, max. dem. etc.	Aron and Bastian	400	Coal, single nuts	£40,796, includ. mains	£13,288	3/11	All.....	250 v. ..
Direct ..	Non-condensing	Callender, triple conc. fdrs., 3 core dist.	7,172 8 c p	4 500 well arcs, 7 25 c.p.	4,500....	Ltg. 7d. & 4d., pwr. 4d. and 1½d.	Maximum demand	Aron and Hookh'm	300	Welsh coal	—	—	—	All.....	210 v. ..
Direct ..	—	Armoured cables	3,000 8 c.p.	—	—	6d.	Discounts	—	120	Welsh coal	£5,500	£3,000	—	All.....	—
Direct ..	Non-condensing	Bare strip Crompt. sys., Call cabs. in i. case or pi. & ld. sol.	13,635 8 c.p. and 18 arcs	—	2,835....	Lighting 7d., power 4d.	—	Ferranti, Thomson, Schattner, and Bastian	353	Welsh coal	About £19,100	About £19,500	Abt. 8/-	All.....	220 v. ..
Direct ..	Condensing....	Silvertown rub. cv. in wdn. troughing with bit.	10 arcs, 7,177 8 c p.	—	—	Ltg. 6d. & 4d., pwr. 3d.	Wright's	Ferranti and demand indicator	200, also 250 k. by Spt. '01	Tredegar wd pea nuts & coke	£11,572	£2,806	—	All.....	220 v. ..
Direct coupled	Non-condensing	Callender triple conc. feeders, cbls. lead covd. & arm'rd	13 = 10 amp. arcs, 11,432 8 c.p.	10 arcs, 211 16 c.p.	9,274....	7d., 4d. & 2d., fac. 5d.; pwr. 4d. & 1½d.	Wright's max. demand	Reason, Bastian, Ferranti, Hookham, and Aron	444	Warwick hard steam	£23,709	£15,940	4/10	16,910	210 v. ..
Direct ..	Non-condensing	In culvrts., and i.r. cable in c.i. pipes	52,913 8 c.p.	20 8 c.p. ..	8,021....	7d. and 4d., with discounts	Brighton	Ferranti	1,203	Welsh coal	£45,620§	£45,760	5/3	36,016	220 v. ..
Direct ..	Condensing....	Bare strip & arm'rd. conc., 3 core jute ins. lead covd. and arm'rd.	84,500 8 c p.	—	24,430 ..	5d. or 5½d. first hr., 2½d. after, power 2½d.	Brighton	Hookham, Ferranti, and Thomson	3,365	Steam coal	£90,681	£75,441	—	Majority	110 v. a 220 v.
Belts....	—	Callender, lead cov. and armoured	2 arcs, 772 incand.	32 32 c.p...	400	6d.	Flat rate and contract	Schattner and Bastian	23	Water power	£6,000		6/8	120 200 v.	100 v. a 200 v.
Belt	Non-condensing	Overhead	2,160 8 c.p.	12 50 c.p., 76 20 c.p.	210, and 120 c.p. for streets	Ltg. 6d. & 5d., power 3d.	—	Hookham	68	Coal	£3,500	£950	5/2	216, 230 v.	115 v. a 230 v.
Belts and direct	Steam engine, condensing	Conc. fdrs. lead. sh., partly cond., partly arm'd laid dir.	12 arcs, 7,800 8 c.p.	22 arcs, 1,680 8 c.p.	2,620....	Lighting 5d., power 3d.*	Chiefly uniform	Ferranti, Thomson, and Schattner	320	Coke and steam coal	About £38,000	—	—	All.....	200 v. ..
Direct ..	Condensing....	Callender bitumen cable	Mar. 1900, 28,719 8 c.p.	30 arcs, 57 incand.	—	Lighting 4½d., power 3d.	Flat rate, 5 % dis.	Principally Hookham	420	Burgie	£32,795		5/1½	None	100 v. a 200 v.
Ropes and belts	Condensing....	Callender, brick culverts, solid and conc. lead covd. and arm'rd	9,868 8 c.p.	—	—	Ltg. 7d. to 5d., power 4d.	Rebate*..	Hookham	304	Coal	—	—	6/2	—	113 v. ..
Direct ..	Non-condensing at present	Paper ins., triple conc., solid and conduits	2,113.....	—	4,252....	Ltg. 7d. & 2½d., pwr. 3d. and 1½d.	Wright's	Hookham	200	Coke breeze and refuse	£8,200	£2,000	—	All.....	220 v. ..
Direct ..	Non-condensing	B.I.W., laid direct, also solid in wood troughing	24,600 8 c.p.	110 arcs ..	10,932 ..	Lighting 5d., power 1½d.	Flat rate	Ferranti and Aron	640	Washed pearls, etc.	£27,724	£16,346	3/6	—	230 v. a 460 v.
Belts and direct	Non-condensing	Siemens conc. in Doulton con. arm. West. Elec., Callender and Henley	25,000 8 c.p.	63 arcs, 229 incand.	10,000 ..	Ltg. 5d. & 2d., pwr. 5d. & 1d.	Brighton	Ferranti, Thomson, and Hookham	800	Welsh anth. & hd. stm.	£90,000	£40,500	4/7½	None	150 volts
Direct coupled	Ejector condensers	Arm'rd conc., and triple conc. laid in bitumen	About 14,000 8 c.p.	30 arcs, 116 16 c.p.	—	6d. and 2½d.	Brighton	Ferranti and Schattner	598	Coal	£34,273	£10,457	—	—	230 v. ..
Direct ..	Condensing and non-condensing	Callender solid	296,584 8 c.p.	142 arcs ..	30,519 16 c.p.	Ltg. 4d., pwr. 2d. & 1½d.	—	Hookham and Ferranti	11,110	Slack	—	—	—	—	230 v. ..
Direct ..	Ledward evaporative condrs.	Triple con. feeders, 3 core distributors	12,000 8 c.p.	48 arcs	3,000....	6d.; or 7d. and 3½d.	Flat rate and m.d.	Bastian, Ferranti, and Hookham	400	Coke.....	£32,000	£12,000	9/3	—	220 v. ..
Belt	Condensing....	Steel armoured	—	187 arcs ..	—	—	—	—	180	Welsh coal	£20,000		—	—	—
Direct ..	Non-condensing	Callender, jute ins., trpl. conc. feeders, 3 core dist.	—	350 8 c.p ..	1,705....	Ltg. 7d. & 4d., pwr. 4d. and 1½d.	Wright's	Hookham and Reason, 1s. in slot	62	Welsh coal	—	—	—	All.....	240 v. ..
Belt	Non-condensing	Bare wire overhead	1,000 8 c.p., 6 arcs	11 incand...	50	4½d.	Flat rate and cont.	Hookham and Bastian	49	Small coal and refuse	£2,000		—	All	220 v. ..
Belts and direct	Condensing....	Bare cop. con. cul., vul. rub. in p. vul. rub., vul. bit., & ld. cov. B.I.W. laid sol.	2,256 arcs, 37,913 8 c.p.	29 arcs	73,300 ..	5d.; or £7 kw., inst. plus 1½d. unit, spcl. pwr. rts. 1½d. or 2½d.	Flat rate and Hopkinson	Ferranti, Thomson, Aron, & Hookham	7,250	Washed slack	£302,932, to Mar. 31, 1900	£338,890	6/2	A considerable number	100 v., 2 v., 300 or 400
Direct coupled	Condensing (Korting's)	Triple conc. feeders, 3 core dist.	3 arcs, 2,002 8 c p.*	—	Started Nov., 1900	7d. and 4d.	Maximum demand	Hookham and Reason	175	Annesley slack	—	—	—	All.....	240 v. ..
Belt	Non-condensing	Overhead wire	—	36 incand...	—	7½d.	Flat rate and cont.	Thomson and Hookham	—	Welsh steam coal	—	—	—	—	—
Direct ..	Korting ejector condensers	Solid system, with arm'rd services	10,000	None	All.....	7d. and 2d.	Wright's max. dem.	Hookham	500	Durham peas	Not obtainable yet		—	All.....	220 v. a 440 v.
Belt	Non-condensing	Overhead and i.r. cables in pipes	8 arcs, 900 incand.	—	—	—	By contract	—	66	Coal	—	—	—	—	100 v. ..
Direct coupled	Condensing ..	H.P. fds. con., solid, twin cbs., L.P. fds. & dis., Callender conc.	30 arcs	104 arcs, 96 incand.	—	5d. or 7d. and 3d.	Flat rate & max. dem.	Hookham	490	Coal	£35,211	£8,000	—	12,000	220 v. ..
Direct ..	Non-condensing	Callender lead covd. arm'rd conc. and triple conc. laid direct	2,500.....	30 10 amp. arcs, 500 32 c.p. incand.	All.....	Lighting 5d., power 2½d.	Flat rate	Aron.....	200	Dross	About £24,000	—	—	—	230 v. ..
Direct ..	—	Lead covd. vul. and B.I.W. cbs. in c.i. pipes, conc. earthenware troughs	8,500 8 c.p.	4 arcs	600	Lighting, 5d., power 3d.	Flat rate & disct.	Ferranti and Hookham	110	Coal and coke	£6,700	£6,000	4/6	—	110 v. ..
Direct coupled	Non-condensing	Triple conc. fdrs, 3 core dist., Callender lead cov. and arm'rd, laid direct	14 arcs, 6,618 8 c.p.	—	2,303....	Ltg. 7d. & 4d., pwr. 4d. & 2½d.	Wright..	Hookham and Schattner	110	Hard Yorks. steam coal	£22,561	£11,461	—	—	210 v. ..
Direct and belt	Non-condensing	Bare aluminium, overhead ..	1 arc, 1,980 8 c.p.	22 arcs, 49 incand.	1,180....	Lighting 6d., power 4d.	Sliding scale	Hookham and Bastian	128	Durham threbles	About £4,000	£860	—	All.....	225 v. ..
Direct and ropes	Non-condensing	Bare strip	19,763 8 c.p.	2 arcs	6,702....	6½d. and 3½d. 5% dis., 3½d. & 1½d. motor pr.	Brighton	Hookham	505	Coal and slack	£31,000		6/10	—	210 v. ..
Belting..	—	B.I.W., triple conc. and arm'rd., laid direct in gr'nd	9,094 8 c.p.	Equivalent 88 8 c.p.	2,908....	6d. and 4d.	Brighton	Hookham, Aron, & Long-Schattner	194	Mond producer gas	—	—	—	—	220 v. ..
Direct ..	Körting condenser to each engine	Bare copper in culverts, and B.I.W. cable	252 arcs, 29,630 16 c.p.	—	9,800 ..	5d.	—	Scott, Hookham, and Schattner	1,674	Coal	£65,456 (inc. site)	£49,554	7/9	Outlying districts	110 v. a 220 v.
Direct ..	—	Callender.....	100,378 8 c.p.	15 arcs	14,378	Ltg. 5d. to 2d., power 1½d.	Brighton	Ferranti and Hookham	2,940	Coal	£166,098 (31st Mar., 1900)		4/10	—	200 v..
Belt	Non-condensing	Overhead wires	1,000 16 c.p.	180 incand.	100	6d. and 8d.	Contract chiefly	Ferranti	850 amp.	Small coal	£5,565		8/9 and 12/6	None	100 v. 115 v.
Direct ..	Condensing....	Bare strip & rub. & B.I.W. cabs. in iron pipes & bit. cabs. solid	40,000 8 c.p. (Jan., 1901)	28 arcs	—	4d. & 2d., str'et lighting 2½d.	Brighton (2 hours)	Ferranti	1,332	Slack coal	£41,201 (March,	£25,223 1900)	5/3½	All.....	210 v. a 105 v.
Ropes and direct	Non-condensing	Callender armoured cables ..	4,600 8 c.p.	—	600	7d.	Brighton (2 hours)	Ferranti and Thomson	173	Coal	£7,100		3/4	All.....	220 v. ..
Ropes belt..	Condensing....	H.T. i.r. cables in iron pipes L.T. Callender	30 arcs and 33,000 8 c.p.	32 arcs and 48 16 c.p.	3,700....	6d.	—	Hookham and	855	Welsh coal	£71,000	£40,000	8/-	—	100 v. ..

8/37	W. of Scot. wshd. dbls.	—	—	4/3½	230 v. almost entirely	230 v.	451 = 1,434½ h.p.	Data refer to year ending 15th May, 1900	Frank A. Newington	**Edinburgh ‡ ....(38)**	
ohn- 120	Town refuse and coal	£15,000	£7,000	—	—	200 v.	5 = 20 h.p.....	600 ampere-hour chloride battery	'Osborn Hansom	**Fleetwood and District (39)**	
ranti —	Welsh coal	—	—	—	All	210 v.	9 = 22½ h.p.	—	Thos. Hesketh	**Folkestone ....(40)**	
— 130	—	£9,500		—	150 volt lamps	150 v.	4 h.p.	—	Irvine Reid....	**Fort William †..(41)**	

(87) Oswestry	Oswestry Electric Light and Power Co.	2 wire	2 loco.	Mountain				Mountain		1 80 kw.	direct				
(88) Oxford	Oxford Electric Light Co.	Sub-station,	5 loco., 1 economic	3 vertical 1 do. 600	150 h.p., 1 do. 200 h.p., h.p.: 1 450 h.p., Willans			E.C.C., 1,000 v.		3 90 kw., 1 100 kw., 1 260 kw., 1 225 kw.	Ropes belt and		Condens		
.....	Various	60 to 750 kw.	Direct ..	Non-condensing	Armoured cable and bare copper strip	253,886 8 c.p.	747 arcs ..	69,848 ..	Lighting 3½d., power 1½d.	Reb. 25 % light only	—	8,837	W. wsh		
.....	Johnson-Phillips	60 kw.	Direct coupled	Non-condensing	Western Electric paper ins. lead cov., arm'd, laid direct	9 arcs, 4,000 incand.	12 arcs, 500 incand.	All.....	Lighting 6d., power 3d.	Flat rate	Bastian and Johnson-Phillips	120	Tow and		
Peache	Parker	2 160 and 460 v., 2 370 and 460 v.; 2 320 kw., 2,500 v. adding	Direct ..	Non-condensing	Callender feeders conc., distributors 3 core	About 16,357 8 c.p.	66 arcs & 2 incd. each	6,357....	Lighting 7d., power 1d.	Wright's	Aron and Ferranti	—	Wels		
.p., turbines,	Laurence, Scott & Co., General Electric	45 kw., 30 kw.....	Direct ..	—	Overhead and underground..	4,500 8 c.p.	6 arcs, 52 incand.	500	6½d.	—	—	130			
rbines; 1 32	Statter and Crompton	Largest 32 kw., smallest 4 kw.	Belts....	No steam engines used	Bare cop. tbs. in stn. p., arm. bit. cab., ld. cov. diatrn. in bitu.	7 arcs, 3,077 8 c.p.	7 arcs, 4 incand.	About 400	Lighting 5d., power 3d.	Contract and meter	Hookham, Thomson, and Aron	83·5	Coke coa		
3 250 h.p., 6 .p., Willans; h.p., Belliss; Lellan; 1 900 , Ball-Wood; Watson	13 Siemens, 6 Crompton, 2 British Thomson-Houston, 2 Walker, 2 Mavor-Coulson, 1 Schuckert	2 48 kw., 2 90 kw., 3 160 kw., 6 240 kw., 4 750 kw., 2 260 kw., 2 130 kw.	All coupled direct	Waterloo Street works non-condensing; Port Dundas condensing	Bare strip, rubber cables i. p., arm'd lead covered jute and B I.W. paper cables, separate and concentric in iron and wood troughs	291,665 8 c.p., Dec. 31st, 1900	265 arcs ..	—	6d. first hr., after, 2½d. 100 v., 2d. 200 v., 1½d. 250 v.; over 8 hrs. no 6d. units	Maximum demand & fixed rate	Ferranti, Hookham, and Bastian	6,402	Coal		
.p., Belliss;	4 Silvertown, 2 Mather-Platt	2 75 kw., 4 150 kw.	Direct ..	Condensing....	Callender cables, solid.....	13,400 8 c.p	52 10 amp. arcs	13,400 ..	Ltg. 7d. & 2d., pwr. 4½d. & 1½d.	Maximum demand	Hookham	750	Slack		
ne	Elwell-Parker	22 kw.	Belt	—	Overhead.....	570 8 c.p...	—	30	1/3 per candle per annum	Contract	—	22	Bitu coa		
, Belliss	2 British Thomson-Houston, 1 Silvertown	2 95 kw., 1 200 kw.	Direct coupled	Non-condensing	Callender lead covd. arm'rd cables laid direct	12,000 8 c.p.	85 10 amp. arcs	9,000....	6d. 1st hr., 2d. after	Maximum demand	Ferranti and dem. indicators	390	Scot dro		
Willans....	1 Robinson, 1 Siemens, and 3 Parker	2 43 kw., 3 86 kw...	Direct ..	Non-condensing	Callender, solid	8 arcs, 11,842 inc.	16 arcs	3,622....	6d.	Flat rate	Hookham	348	Best slac		
., 1 350 i.h.p.,	—	4 22 kw., 4 93 kw., 1 220 kw.	Direct ..	Condensing....	B.I.W., solid	—	60 arcs	—	5d.	Flat rate	Hookham	670			
.p., Belliss ..	Silvertown, 2 shunt, 300 v., 2 compound, 600 v.	2 50 kw. (300 v.) 2 150 kw. (600 v.)	Direct coupled	Non-condensing	Callender solid and Callender-Webber casing, single cables	11,300	44 10 amp. arcs	11,295 ..	5½d. flat; 2d. fxd. ch.; 7d. & 1½d. m.d.; pwr. 2d.	Flat rate, max. dem. etc.	Aron and Bastian	400	Coal nut		
p., Belliss..	Parker	2 75 kw., 1 150 kw.	Direct ..	Non-condensing	Callender, triple conc. fdrs., 3 core dist.	7,172 8 c p	4 500 well arcs, 7 25 c.p.	4,500....	Ltg. 7d. & 4d., pwr. 4d. and 1½d.	Maximum demand	Aron and Hookh'm	300	Wels		
o.	—	3 20 kw., 1 60 kw. ..	Direct ..	—	Armoured cables	3,000 8 c.p.	—	—	6d.	Discounts	—	120	Wels		
.....	Crompton and Mather-Platt	3 60 kw., 1 23 kw., 1 150 kw.	Direct ..	Non-condensing	Bare strip Crompt. sys., Call cabs. in i. case or pi. & ld. sol.	13,635 8 c.p. and 18 arcs	—	2,835....	Lighting 7d., power 4d.	—	Ferranti, Thomson, Schattner, and Bastian	353	Wels		
1 375 i.h.p.,	India-rubber & Gutta Percha Co.	200 amps., 500 volts each; 2 100 kw., 1 250 kw. on order	Direct ..	Condensing....	Silvertown rub. cv. in wdn. troughing with bit.	10 arcs, 7,177 8 c p.	—	—	Ltg. 6d. & 4d., pwr. 3d.	Wright's	Ferranti and demand indicator	200, also 250 k. by Spt. '01	Trede pea cok		
h.p., Peache	Parker	2 72 kw., 2 150 kw.	Direct coupled	Non-condensing	Callender triple conc. feeders, cbls. lead covd. & arm'rd	13 = 10 amp. arcs, 11,432 8 c.p.	10 arcs, 211 16 c.p.	9,274....	7d., 4d. & 2d., fac. 5d.; pwr. 4d. & 1½d.	Wright's max. demand	Reason, Bastian, Ferranti, Hookham, and Aron	444	Warw hard		
., 2 360 h.p., 1 150 h.p.,	Crompton	3 60 kw., 3 154 kw., 1 90 kw., 2 222 kw., 1 23 kw.	Direct ..	Non-condensing	In culvrts., and i.r. cable in c.i. pipes	52,913 8 c.p.	20 8 c.p. ..	8,021....	7d. and 4d., with discounts	Brighton	Ferranti	1,203	Wels		
, 2 300 h.p., p., Willans; ., Allen	4 Siemens, 110 v.; 2 Holmes, 220 v.; 2 Parker, 220 v., 6 do., 2,250 v., 1 do. 440 v.	2 44 kw., 3 115 kw., 2 180 kw., 2 45 kw. 2 202 kw., 4 520 kw.	Direct ..	Condensing....	Bare strip & arm'rd. conc., 3 core jute ins. lead covd. and arm'rd.	84,500 8 c p.	—	24,430 ..	5d. or 5½d. first hr., 2½d. after, power 2½d.	Brighton	Hookham, Ferranti, and Thomson	3,365	Stea		
5 to 20 h.p.,	Hall	35 to 45 amps., 330 to 250 v.	Belts....	—	Callender, lead cov. and armoured	2 arcs, 772 incand.	32 32 c.p...	400	6d.	Flat rate and contract	Schattner and Bastian	23	Wate		
vey-Paxman)	Johnson-Phillips and Taunton	2 9·5 units, 1 24 units	Belt	Non-condensing	Overhead	2,160 8 c.p.	12 50 c.p., 76 20 c.p.	210, and 1 20 c.p. for streets	Ltg. 6d. & 5d., power 3d.	—	Hookham	68	Coal		
Fielding and steam	General Electric Co.	5 40 kw. and 1 120 kw.	Belts and direct	Steam engine, condensing	Conc. fdrs. lead. sh., partly cond., partly arm'd laid dir.	12 arcs, 7,800 8 c.p.	22 arcs, 1,680 8 c.p.	2,620....	Lighting 5d., power 3d.*	Chiefly uniform	Ferranti, Thomson, and Schattner	320	Coke stea		
, 1 135 h.p.,	3 Brush, 1 Mather-Platt....	1 120 kw., 1 80 kw., 1 36 kw., 1 180 kw.	Direct ..	Condensing....	Callender bitumen cable	Mar. 1900, 28,719 8 c.p.	30 arcs, 57 incand.	—	Lighting 4½d., power 3d.	Flat rate, 5 % dis.	Principally Hookham	420	Burg		
.....	Chamberlain-Hookham	4 80 kw., 1 30 kw...	Ropes and belts	Condensing....	Callender, brick culverts, solid and conc. lead covd. and arm'rd	9,868 8 c.p.	—	—	Ltg. 7d. to 5d., power 4d.	Rebate*..	Hookham	304	Coal		
.....	Mather-Platt	2 80 kw.	Direct ..	Non-condensing at present	Paper ins., triple conc., solid and conduits	2,113.....	—	4,252....	Ltg. 7d. & 2½d., pwr. 3d. and 1½d.	Wright's	Hookham	200	Coke and		
, 1 300 h.p.,	Silvertown	4 92 kw., 1 60 kw., 1 212 k.w.	Direct ..	Non-condensing	B.I.W., laid direct, also solid in wood troughing	24,600 8 c.p.	110 arcs ..	10,932 ..	Lighting 5d., power 1½d.	Flat rate	Ferranti and Aron	640	Wash pear		
, 4 85 b.h.p., Willans	Faller-Wenström, E.C.C., General Electric Co., and Mather-Platt	4 35 kw., 4 52 kw., 4 227 kw.	Belts and direct	Non-condensing	Siemens conc. in Doulton con. arm. West. Elec., Callender and Henley	25,000 8 c.p.	63 arcs, 229 incand.	10,000 ..	Ltg. 5d. & 2d., pwr. 5d. & 1d.	Brighton	Ferranti, Thomson, and Hookham	800	Welsh & h		
, Willans..	Laurence, Scott & Co	3 66 kw., 2 200 kw.	Direct coupled	Ejector condensers	Arm'rd conc., and triple conc. laid in bitumen	About 14,000 8 c.p.	30 arcs, 116 16 c.p.	—	6d. and 2½d.	Brighton	Ferranti and Schattner	598	Coal		
p., Willans	Siemens and E.C.C.	160 kw. and 600 kw.	Direct ..	Condensing and non-condensing	Callender solid	296,584 8 c.p.	142 arcs ..	30,519 16 c.p.	Ltg. 4d., pwr. 2d. & 1½d.	—	Hookham and Ferranti	11,110	Slack		
1 240 h.p.,	Silvertown	2 100 kw., 1 50 kw., 1 150 kw.	Direct ..	Ledward evaporative condrs.	Triple con. feeders, 3 core distributors	12,000 8 c.p.	48 arcs	3,000....	6d.; or 7d. and 3½d.	Flat rate and m.d.	Bastian, Ferranti, and Hookham	400	Coke.		
0 h.p.	Siemens	6 30 kw.	Belt	Condensing....	Steel armoured	—	187 arcs ..	—	—	—	—	180	Welsh		
.....	Parker	62 kw.	Direct ..	Non-condensing	Callender, jute ins., trpl. conc. feeders, 3 core dist.	—	350 8 c.p ..	1,705....	Ltg. 7d. & 4d., pwr. 4d. and 1½d.	Wright's	Hookham and Reason, 1s. in slot	62	Welsh		
.....	Crompton	39 kw.	Belt	Non-condensing	Bare wire overhead	1,000 8 c.p., 6 arcs	11 incand...	50	4½d.	Flat rate and cont.	Hookham and Bastian	49	Small and		
.p. 2 1,000	11 bi-polar, 4 multi-polar ..	11 250 kw., 2 1,500 kw., 2 750 kw.	Belts and direct	Condensing....	Bare cop. con. cul., vul. rub. in p. vul. rub., vul. bit., & ld. cov. B.I.W. laid sol.	2,256 arcs, 37,918 8 c.p.	29 arcs	73,300 ..	5d.; or £7 kw., inst. plus 1½d. unit, spcl. pwr. rts. 1½d. or 2½d.	Flat rate and Hopkinson	Ferranti, Thomson, Aron, & Hookham	7,250	Wash		
ines	—	75 kw.	Direct coupled	Condensing (Korting's)	Triple conc. feeders, 3 core dist.	3 arcs, 2,002 8 c p.*	—	Started Nov., 1900	7d. and 4d.	Maximum demand	Hookham and Reason	175	Annes		
.....	Crompton	26 kw.	Belt	Non-condensing	Overhead wire	—	36 incand...	—	7½d.	Flat rate and cont.	Thomson and Hookham	—	Welsh coal		
tt-Lindley; others	P. R. Jackson & Co., Sayer's winding	2 55 kw., 1 300 kw...	Direct ..	Korting ejector condensers	Solid system, with arm'rd services	10,000	None	All.....	7d. and 2d.	Wright's max. dem.	Hookham	500	Durha		
.....	2 Wilson	—	Belt	Non-condensing	Overhead and i.r. cables in pipes	8 arcs, 900 incand.	—	—	—	By contract	—	66	Coal .		
., Peache; arsons	Parker and Parsons	3 90 kw., 1 200 kw., 2 10 kw.	Direct coupled	Condensing ..	H.P. fds. con., solid, twin cbs., L.P. fds. & dis., Callender conc.	30 arcs	104 arcs, 96 incand.	—	5d. or 7d. and 3d.	Flat rate & max. dem.	Hookham	490	Coal .		
Villans	Mavor-Coulson	2 80 kw., 2 20 kw. ..	Direct ..	Non-condensing	Callender lead covd. arm'rd conc. and triple conc. laid direct	2,500.....	30 10 amp. arcs, 500 32 c.p. incand.	All.....	Lighting 5d., power 2½d.	Flat rate	Aron.....	200	Dross		
.....	Seimens and Holmes	77 kw.	Direct ..	—	Lead covd. vul. and B.I.W. cbs. in c.i. pipes, conc. earthenware troughs	8,500 8 c.p.	4 arcs	600	Lighting, 5d., power 3d.	Flat rate & disct.	Ferranti and Hookham	110	Coal		
1 200 h.p.,	Parker	2 55 kw.	Direct coupled	Non-condensing	Triple conc. fdrs, 3 core dist., Callender lead cov. and arm'rd, laid direct	14 arcs, 6,618 8 c.p.	—	2,303....	Ltg. 7d. & 4d., pwr. 4d. & 2½d.	Wright..	Hookham and Schattner	110	Hard steam		
MacLellan;	1 G.E.C., 2 Crompton	1 74 kw., 2 24 kw. ..	Direct and belt	Non-condensing	Bare aluminium, overhead ..	1 arc, 1,980 8 c.p.	22 arcs, 49 incand.	1,180....	Lighting 6d., power 4d.	Sliding scale	Hookham and Bastian	128	Durha th		
h.p., 2 240 p., Belliss	Crompton and 1 E.C.C.	2 64 kw., 1 68 kw., 1 25 kw., 1 44 kw., 2 120 kw.	Direct and ropes	Non-condensing	Bare strip	19,763 8 c.p.	2 arcs	6,702....	6½d. and 3½d. 5% dis., 3½d. & 1½d. motor pr.	Brighton	Hookham	505	Coal a		
gas engns.,	Laurence, Scott & Co.	2 60 kw., 2 7 kw., gas-driven boosters	Belting..	—	B.I.W., triple conc. and arm'rd., laid direct in gr'nd	9,094 8 c.p.	Equivalent 88 8 c.p.	2,908....	6d. and 4d.	Brighton	Hookham, Aron, & Long-Schattner	194	Mond ducer		
p., 2 200 700 i.h.p.,	Norwich	6 30 kw., 3 81 kw., 2 125 kw., 3 187 kw., 1 440 kw.	Direct ..	Körting condenser to each engine	Bare copper in culverts, and B.I.W. cable	252 arcs, 29,630 16 c.p.	—	9,800 ..	5d.	—	Scott, Hookham, and Schattner	1,674	Coal .		
360 h.p.,	Siemens	—	Direct ..	—	Callender.....	100,378 8 c.p.	15 arcs	14,378	Ltg. 5d. to 2d., power 1½d.	Brighton	Ferranti and Hookham	2,940	Coal .		
.....	J. C. Howell	1 200 amps., 1 300 amps., 5 70 amps.	Belt	Non-condensing	Overhead wires	1,000 16 c.p.	180 incand.	100	6d. and 8d.	Contract chiefly	Ferranti	850 amp.	Small		
200 h.p.,	Charlesworth Hall and Siemens	2 36 kw., 2 60 kw., 2 120 kw., 4 225 kw.	Direct ..	Condensing....	Bare strip & rub. & B.I.W. cabs. in iron pipes & bit. cabs. solid	40,000 8 c.p. (Jan., 1901)	28 arcs	—	4d. & 2d., str'et lighting 2½d.	Brighton (2 hours)	Ferranti	1,332	Slack		
1 Scott-	2 Parker, 1 Siemens, 1 Scott-Mountain	2 30 kw., 1 33 kw., 1 80 kw.	Ropes and direct	Non-condensing	Callender armoured cables ..	4,600 8 c.p.	—	600	7d.	Brighton (2 hours)	Ferranti and Thomson	173	Coal ..		
200 h.p., p., Willans	E.C.C., 1,000 v.....	3 90 kw., 1 100 kw., 1 260 kw., 1 225 kw.	Ropes, belt and direct	Condensing....	H.T. i.r. cables in iron pipes L.T. Callender	30 arcs and 33,000 8 c.p.	32 arcs and 48 16 c.p.	3,700....	6d.	—	Hookham and Ferranti	855	Welsh		
nderson &	Fynn	4 75 kw.	Direct ..	Condensing....	Callender triple conc., solid	3,084 8 c.p.,	18 arcs, 200	—	Lighting 6d.,	Discounts	Ferranti	80	Scot		

	Supply Co., Ltd.				Crossley						driven boosters				
(83) Norwich	Norwich Electricity Sup-	3 wire	Babcock ..	3 100 i.h.p., 3 135 i.h.p., 2 200		Norwich		6 30 kw., 3 81 kw.,		Direct ..					

Ropes direct	Non-condensing....	H.T. i.r. cables in iron pipes L.T. Callender			30 arcs and 32 arcs and 33,000 c.p.	3,700....	6d.	(2 hours)	Thomson Hookham and	855	Welsh coal	£71,000	£40,000	8/-	
	8,837	W. of Scot. wshd. dbls.	—	—	4/3½	230 v. almost entirely	230 v.	451=1,434½ h.p.	Data refer to year ending 15th May, 1900	Frank A. Newington	**Edinburgh** ‡ ....(38)				
ohn-	120	Town refuse and coal	£15,000	£7,000	—	—	200 v.	5 = 20 h.p.....	600 ampere-hour chloride battery	Osborn Hansom	**Fleetwood and District** (39)				
anti	—	Welsh coal	—	—	—	All	210 v.	9 = 22½ h.p.	——	Thos. Hesketh	**Folkestone** ....(40)				
	130	—	£9,500		—	150 volt lamps throughout	150 v.	4 h.p.	——	Irvine Reid....	**Fort William** †..(41)				
om- n	83·5	Coke, anth. coal	£8,000	£2,100	8/-	None	110 v.	7 = 8¼ h.p.....	Con. eng. and man. direct James Perry	Arthur B. Child	**Galway** .....(42)				
ook- stian	6,402	Coal	£609,000, includ. mains	£316,000	6/3	100 v., 200 v., 250 v.	250 v.	800 h.p.	Waterloo Station 3,300 h.p.; Port Dundas, 10,800 h.p.; St. Andrew's Cross, 2,400 h.p.; Kelvinside, 1,080 h.p.	W. A. Chamen	**Glasgow** .....(43)				
....	750	Slack	£55,000	£16,000	—	All.....	220 v. and 440 v.	8 = 14 h.p.....	First year's working not yet completed	W. J. Bache ..	**Gloucester** ....(44)				
	22	Bituminous coal	£1,000	£200	10/-	—	100 v.	—	——	D. Powell	**Gorseinon**.....(45)				
lem.	390	Scotch coal, dross	£26,000		—	—	250 v.	3 = 25 h.p.....	Tudor battery	James Brown ..	**Govan**.....(46)				
....	348	Best Lancs. slack	£14,951	£16,764	—	—	220 v.	2 = 5 h.p.	——	W. Miles Horsfall	**Great Crosby and Waterloo with Seaforth** .....(47)				
....	670	—	Estimd. £55,000	—	—	—	230 v.	—	——	W. A. Vignoles	**Great Grimsby** (48)				
ian	400	Coal, single nuts	£40,796, includ. mains	£13,288	3/11	All.....	250 v.	10 = 58 h.p. ..	50 kw., storage battery..	W. M. Nelson..	**Greenock** .....(49)				
kh'm	300	Welsh coal	—	—	—	All.....	210 v.	8 = 15 h.p.....	Supply started Feb. 21st, 1900	W. H. Druce ..	**Guernsey** .....(50)				
	120	Welsh coal	£5,500	£3,000	—	All.....	—	—	——	J. M. V. Money-Kent	**Guildford**† ....(51)				
ison, and	353	Welsh coal	About £19,100	About £19,500	Abt. 8/-	All.....	220 v.	4 = 6½ h.p.....	——	Arthur H. Shaw	**Harrow-on-the-Hill** (52)				
de- or	200, also 250 k.by Spt. '01	Tredegar wd pea nuts & coke	£11,572	£2,806	—	All.....	220 v.	7 = 30½ h.p. ..	Chloride battery, 270 cells	F. G. Poulton..	**Hereford** .....(53)				
ian, ook- on	444	Warwick hard steam	£23,709	£15,940	4/10	16,910	210 v.	225 h.p.	Total revenue, £4,102; max. demand, 258 kw.; units sold, 233,108	E. Salthouse ..	**High Wycombe** (54)				
....	1,203	Welsh coal	£45,620§	£45,760	5/3	36,016	220 v.	30 = 61 h.p. ..	§Exclusive of motors and demand meters, £6,716	C. Bottomley Smith	**Hove** .....(55)				
	3,365	Steam coal	£90,681	£75,441	—	Majority	110 v. and 220 v.	81 = 407 h.p. approximately	110 v. plant now being displaced	A. S. Barnard..	**Hull** .....(56)				
tian	23	Water power	£6,000		6/8	120 200 v.	100 v. and 200 v.	—	Mains supplied through D.P. battery	H. W. Brotherton	**Ingleton**.....(57)				
...	68	Coal	£3,500	£950	5/2	216, 230 v.	115 v. and 230 v.	2 = 6½ h.p.....	——	G. J. T. Parfitt..	**Keynsham** † ....(58)				
ison, r	320	Coke and steam coal	About £38,000	—	—	All.....	200 v.	4 = 5 h.p.	* Optional charge, £7 per kw. installed, and 3d. per unit	J. Pilling	**King's Lynn** ....(59)				
nam	420	Burgie	£32,795		5/1½	None	100 v. and 200 v.	40 = 200 h.p..	——	—	**Lancaster**.....(60)				
...	304	Coal	—	—	6/2	—	113 v.	4 = 10 h.p.....	* Reduced after 12 units per 16 c.p. per quarter	F. W. E. Jones	**Leamington** ....(61)				
...	200	Coke breeze and refuse	£8,200	£2,000	—	All.....	220 v.	5 = 58 h.p.....	Supply commenced Jan. 7th, 1900	Jno. Foster	**Leigh** .....(62)				
ron	640	Washed pearls, etc.	£27,724	£16,346	3/6	—	230 v. and 460 v.	34 = 275 h.p...	——	J. Gray Scott, cons. and res. eng.	**Leith** .....(63)				
son,	800	Welsh anth. & hd. stm.	£90,000	£40,500	4/7½	None	150 volts ..	8 = 13 h.p.....	Part of steam plant erecting	F. Harman Lewis	**Leyton** .....(64)				
ner	598	Coal	£34,273	£10,457	—	—	230 v.	10 h.p.....	——	Stanley Clegg..	**Lincoln** .....(65)				
nti	11,110	Slack	—	—	—	—	230 v.	412 = 1,510 h.p.	——	A. Bromley Holmes	**Liverpool**.....(66)				
nti,	400	Coke.....	£32,000	£12,000	9/3	—	220 v.	10 = 40 h.p. ..	——	Harold Morton	**Llandudno** ....(67)				
	180	Welsh coal	£20,000		—	—	—	—	——	R. V. Macrory..	**Londonderry** ..(68)				
slot	62	Welsh coal	—	—	—	All.....	240 v.	2 i.h.p.....	Supply commenced Dec. 8th, 1900	Edgar Hesketh	**Lymington** ....(69)				
ian	49	Small coal and refuse	£2,000		—	All	220 v.	½ h.p., ½ h.p. ..	——	W. Jas. Price	**Maerdy** .....(70)				
son, am	7,250	Washed slack	£302,932, to Mar. 31, 1900	£338,890	6/2	A considerable number	100 v., 200 v., 300 v. or 400 v.	629 = 2,487 h.p.	Plant on order 4 1,800 kw., all direct driven	G. F. Metzger..	**Manchester** ....(71)				
son	175	Annesley slack	—	—	—	All.....	240 v.	—	*Dec. 31st, 1900	W. H. Russell	**Melton Mowbray** (72)				
am	—	Welsh steam coal	—	—	—	—	—	—	——	J. G. Hill.....	**Mevagissey** ....(73)				
..	500	Durham peas	Not obtainable yet		—	All.....	220 v. and 440 v.	About 15 h.p...	Hart storage batt., 100 kw. for 5 hours. Supply commenced Dec. 1900	Harold W. Clayden	**Middlesbro'** ....(74)				
	66	Coal	—	—	—	—	100 v.	—	——	W. Crookell ..	**Middleton**.....(75)				
..	490	Coal	£35,211	£8,000	—	12,000	220 v.	8 = 26 h.p.....	——	C. F. Parkinson	**Morecambe** ....(76)				
..	200	Dross	About £24,000	—	—	—	230 v.	4 = 6 h.p.	Supply commenced Feb., 1901	S. E. Britton ..	**Motherwell** ....(77)				
am	110	Coal and coke	£6,700	£6,000	4/6	—	110 v.	10 = 15 h.p. ..	Storage battery 88 kw. for 3 hours	W. A. Fraser ..	**Nelson**.....(78)				
er	110	Hard Yorks. steam coal	£22,561	£11,461	—	—	210 v.	1 = 3 h.p.	Paxman economic boiler to be put in this summer	F. A. Simpson..	**Newmarket** ....(79)				
an	128	Durham threbles	About £4,000	£860	—	All.....	225 v.	6 = 15 h.p.	Station running 18 mths.	J. E. Hutton, man. dir.	**Northallerton**..(80)				
..	505	Coal and slack	£31,000		6/10	—	210 v.	50 = 5 h.p.....	——	W. E. J. Heenan	**Northampton** † (81)				
& r	194	Mond producer gas	—	—	—	—	220 v.	9 = 61 h.p.....	A. W. Sclater, cons. eng.	F. W. Ames, res. eng.	**Northwich** ....(82)				
n,	1,674	Coal	£65,456 (inc. site)	£49,554	7/9	Outlying districts	110 v. and 220 v.	130 = 573 h.p.	——	F. M. Long....	**Norwich** .....(83)				
m	2,940	Coal	£166,098 (31st Mar., 1900)		4/10	—	200 v.....	130 = 470 h.p.	——	H. Talbot	**Nottingham**....(84)				
..	850 amp.	Small coal	£5,565		8/9 and 12/6	None	100 v. to 115 v.	70 h.p.....	——	—	**Ogmore Valley** † (85)				
..	1,332	Slack coal	£41,201 (March,	£25,223 1900)	5/3½	All.....	210 v. and 105 v.	26 h.p.....	——	S. Wilmott Newington	**Oldham** .....(86)				
on	173	Coal	£7,100		3/4	All.....	220 v.	2 3 h.p. each ..	——	E. Bremner Smith	**Oswestry** .....(87)				
nti	855	Welsh coal	£71,000	£40,000	8/-	—	100 v.	25 h.p.....	——	Percy J. Rea ..	**Oxford** .....(88)				
	80	Scotch nuts	£32,000	£10,170											

s arm'rd., laid direct in gr nd 88 8 c.p. Long-Schattner ducer gas

kw. Direct Kärting conden Bare copper in culverts and 259 arcs 9,900 5d. Scott Hookham 1,674 Coal £65,456 £49,554 7/9

	1 260 kw., 1 225 kw.	belt and direct		L. T. Callender	33,000 8 c.p.	48 16 c.p.	3,700....	6d.	—	Hookham and Ferranti	855	Welsh
Fynn	4 75 kw.	Direct ..	Condensing....	Callender triple conc., solid	3,084 8 c.p.,	18 arcs, 200	—	Lighting 6d.,	Discounts	Ferranti	80	Scotch

	Supply Co., Ltd.				Crossley			driven boosters		
(83) Norwich	Norwich Electricity Supply Co.	3 wire	Babcock ..	3 100 i.h.p., 3 135 i.h.p., 2 200 i.h.p., 3 300 i.h.p., 1 700 i.h.p., Willans	Norwich	6 30 kw., 3 81 kw., 2 125 kw., 3 187 kw., 1 440 kw.	Direct ..	Ki s
(84) Nottingham ..	Corporation	3 wire	8 Lancs., 7 Dryback	3 80 h.p., 7 134 h.p., 4 360 h.p., 4 700 h.p., Willans	Siemens	—	Direct ..	
(85) Ogmore Valley†	Ogmore Valley Electric Light and Power Co.	2 wire	Loco. type tubular	2 35 h.p. undertype	J. C. Howell	1 200 amps., 1 300 amps., 5 70 amps.	Belt	No
(86) Oldham	Corporation	2 and 3 wire	8 Lancs. ..	2 60 h.p., 2 100 h.p., 2 200 h.p., 4 360 h.p., Willans	Charlesworth Hall and Siemens	2 36 kw., 2 60 kw., 2 120 kw., 4 225 kw.	Direct ..	Co
(87) Oswestry	Oswestry Electric Light and Power Co.	2 wire	1 B. & W., 2 loco.	2 Marshall, 1 Belliss, 1 Scott-Mountain	2 Parker, 1 Siemens, 1 Scott-Mountain	2 30 kw., 1 33 kw., 1 80 kw.	Ropes and direct	No
(88) Oxford	Oxford Electric Light Co.	Sub-station, motor trans.	5 loco., 1 economic	3 vertical 150 h.p., 1 do. 200 h.p., 1 do. 600 h.p.; 1 450 h.p., Willans	E.C.C., 1,000 v.	3 90 kw., 1 100 kw., 1 260 kw., 1 225 kw.	Ropes, belt and direct	Co
(89) Pembroke (Ireland)	Urban District Council..	3 wire	3 Lancs., 1 B. & W.	2 250 h.p., Easton-Anderson & Goolden	Fynn	4 75 kw.	Direct ..	Co
(90) Peterborough	Corporation	3 wire	Lancs.	2 90 h.p., Willans	General Electric Co.....	2 60 kw.	Direct ..	Co
(91) Pontypool	Pontypool Electric Light and Power Co.	2 wire	3 Marshall loco.	1 90 i.h.p., 2 60 i.h.p., 1 25 i.h.p., Willans	Crompton and Parker	2 39 kw., 1 13 kw., 1 70 k.w.	Direct ..	No
(92) Preston	National Electric Supply Co., Ltd.	3 wire, D.C., H.P. altern'g	6 Lancs., 3 Dryback	6 100 b.h.p., 1 200 b.h.p., 2 330 b.h.p., Belliss; 2 750 b.h.p., Willans	Westminster, Siemens, and E.C.C.	6 66, 2 225, 2 16·5 kw. mr.al., 2 510 kw. L.P., 2 70 kw. H.P., alt.	Direct ..	Co
(93) Queenstown ..	The Cork Elec. Tramways and Lighting Co.	3 wire	2 B. & W...	2 100 i.h.p., Belliss	British Thomson-Houston ..	4 25 kw.	Direct ..	Co
(94) Rathmines	Urban District Council..	3 wire	3 Lancs. ..	1 250 i.h.p., 1 575 i.h.p., Willans	4 Mather-Platt	2 75 kw., 2 150 kw...	Direct ..	Co
(95) Richmond (Surrey)	Richmond Electric Light and Power Co., Ltd.	3 wire	3 multitub., 2 econ.	3 100 h.p., 2 60 h.p., 2 200 h.p., Universal	Westminster and Mordey ..	3 67 kw., 2 45 kw., 2 130 kw., 230 v.	Direct ..	No
(96) Rochdale	Corporation	3 wire	2	Belliss	Siemens	—	Direct ..	Bo
(97) Rottingdean ..	New Rottingdean Electricity Co.	2 wire	1 water tube, 1 Paxman	1 25 h.p., Browett; 1 38 h.p., Belliss	Flather and Silvertown	1 20 kw., 1 23 kw. ..	Belt and direct	No
(98) Salisbury	Salisbury Electric Light and Supply Co.	3 wire	3 B. & W.	1 60 h.p., turbine, Gilkes; 1 120 i.h.p., 1 135 i.h.p., 1 220 i.h.p., Belliss	Parker turbine, coupled by gearing & belting to balance set	2 boosters 5 kw., 2 dynamos 23 kw. on one shaft; 1 84 kw., 1 92 kw., 1 150 kw.	—	Wr co
(99) Saltburn-by-the-Sea	Cleveland Trust, Ltd. ..	2 wire	1 for gas generators	2 14 n.h.p. gas engines, Crossley..	2 pole	22 kw.	Belt	
(100) Shrewsbury ..	Corporation	3 wire	4 water tube, 2 Lancs.	3 50 i.h.p., 2 150 b.h.p., 1 350 b.h.p., Belliss	Parker	3 33 kw., 2 100 kw., 1 240 kw.	Direct ..	Nor
(101) Southampton ‡	Corporation	3 wire, 100 and 200 v., and alterg. trans. 2,000 to 200	1 Lancs., 6 Babcock	3 180 h.p., 2 150 h.p., 2 100 h.p., 1 60 h.p., Willans; 1 500 h.p., Ferranti; 1 140 h.p., Belliss	Crompton, 1 Schuckert, 300 kw.	3 120 kw., 2 100 kw., 1 90 kw., 2 60 kw., 1 30 kw., 1 60 kw. motor, 1 300 kw.	Direct ..	Nor
(102) Stafford	Corporation	3 wire	3 Lancs. ..	3 Marshall	E.C.C.....	3 66 kw. each	Rope ..	Jet
(103) St. Austell....	Veale & Co.....	2 wire	Loco. type	3 compound.....	1 Crompton, 2 Kapp, 1 Veale	1 44 kw., 2 21 kw., 1 9 kw.	Belts and counter shafting	Non
(104) St. Helens	Corporation	Sub-stations A.C., 3 wire D.C.	2 Lcs. A.C., 4 Lcs., 2 B. & W., D.C.	A.C., Robey; D.C., Willans	Johnson-Phillips alternators; Mather-Platt and Dick-Kerr, direct current	1 125 kw., 1 25 kw., A.C.; 2 125 kw., 2 215 kw., 1 320 kw., D.C.	Direct ..	Con
(105) Stirling	Town Council.....	3 wire	2 Lancs. ..	2 120 h.p., 2 40 h.p., Belliss	Mather-Platt, 4 pole	2 75 kw., 4 12 kw...	Direct ..	Non
(106) Stockport	Corporation	3 wire	2 Lancs., 2 B. & W.	3 90 h.p., 2 240 h.p., Willans....	McClure-Whitfield	56 and 140 units....	Direct ..	Non
(107) Stockton-on-Tees	Corporation	3 wire	3 Galloway	3 Universal.....	Brush multi-polar.....	2 150 kw., 2 25 kw.	Direct coupled	Non
(108) Sunderland ..	Corporation	3 wire, 110 v., 2 wire, 220 v.	6 Lancs., 2 water tube, 4 Galloway	6 450 h.p., 5 200 h.p., Belliss; 2 50 h.p., Willans	Holmes, Parker, Crompton, Sunderland Forge & Silvertown	2 26 kw., 5 125 kw., 6 275 kw., 2 38 kw.	Direct ..	Non-surf tow
(109) Treeton	Parish Council	Series	—	——	Brush, driven by power supplied from Rother Vale Col'ry	14 kw.	Belt	
(110) Ventnor	Isle of Wight Electric Light and Power Co.	3 wire	B. & W. ..	2 110 b.h.p., Belliss	Parker	84 kw.	Direct ..	Non
(111) Walsall	Corporation	Sub-station motor transformers	2 Lancs., 2 water tube	3 vertical 125 i.h.p., 2 vertical 300 i.h.p.	Parker	3 80 kw., 2 180 kw...	Direct ..	Conc
(112) Whitehaven ..	Corporation	3 wire	Lancs.	6 60 h.p., Willans	Crompton	35 kw.	Direct ..	Conc
(113) Wigan	Corporation	3 wire	B. & W. ..	2 250 i.h.p., 2 350 i.h.p., Willans	G. E. multipolar	2 150 kw., 2 210 kw.	Direct ..	Conc
(114) Winchester †..	Electric Lighting Co. ..	3 wire	3 Babcock	2 80 h.p., 1 300 h.p., Belliss	Parker	2 115 amps., 1 410 amps.	Direct coupled	Non
(115) Windsor	Windsor Electric Installation Co., Ltd.	3 wire	2 Lancs., 3 economic	2 200 i.h.p., 1 100 i.h.p., 1 160 i.h.p., Peache; 1 400 i.h.p., Belliss	Siemens	—	Direct ..	Non
(116) Wolverhampton	Corporation	Sub-stn. mot. trans., and 3 wire	Lancs.	3 250 h.p., 1 120 h.p., 1 200 h.p., 2 350 h.p., 2 800 h.p.	E.C.C. and Parker	4 140 kw., 1 70 kw., 2 220 kw., 2 500 kw.	Rope and direct	Ledw con
(117) York	Corporation	3 wire	2 Lancs., 2 B. & W.	4 130 h.p., 2 260 h.p.	Crompton	4 75 kw., 2 220 kw...	Direct ..	Cond
LONDON.								
(118) Barking	Urban District Council..	3 wire	B. & W. ..	1 60 h.p., 2 130 h.p., Sunderland Forge Co.	Sunderland Forge Co.....	2 20 kw., 2 100 kw.	Direct ..	Non
(119) Chelsea	Chelsea Electricity Supply Co.	3 wire	Water tube	Willans	E.C.C.	80 kw., 150 kw., 200 kw., 400 kw.	Direct ..	Non
(120) Hampstead ..	Hampstead Electric Supply Co., Ltd.	2 wire	5 B. & W...	3 200 h.p., 6 80 h.p., Willans	Siemens, Holmes, Crompton, Latimer Clark, E.C.C.	6 50 kw., 2 100 kw., 1 150 kw.	Direct ..	Non
(121) Kensington ..	Kensington and Knightsbridge Electric Lighting Co.	3 wire.....	6 B. & W...	9 1,910 h.p., 7 250 h.p., 2 80 h.p., Willans	Siemens and Crompton	50 and 150 kw.	Direct ..	Ledw sers
				1 100 kw., 2 180 kw., 3 300 kw., motor generators	——	5,000 v. 3 phase mtrs. driving 200 v. dyms	Direct ..	
(122) Notting Hill ..	Notting Hill Electric Lighting Co.	3 wire	Water tube	Willans	Crompton and Siemens	120 and 200 kw.....	Direct ..	Non
(123) Poplar	Borough Council	3 wire, 460 v. across outers	4 B. & W...	2 400 i.h.p., 2 200 i.h.p., Belliss ..	Mather-Platt	2 250 kw., 2 125 kw.	Direct ..	Surfa
(124) Shoreditch ..	Borough Council	Sub-station motor trans.	Dust destrs. wtr. t'be bls., & semi-mar.	3 300 i.h.p., 3 150 i.h.p., Willans; 3 500 i.h.p., Belliss	E.C.C.	3 165 kw., 3 70 kw., 3 250 kw.	Direct ..	Non
(125) Smithfield Markets	Smithfield Markets Electricity Supply Co.	3 wire	5 economic	4 250 h.p., Windsor; 1 300 h.p., Belliss	4 E.C.C., 1 Parker	4 125 kw., 1 200 kw.	Direct ..	Non
(126) Southwark ..	Borough Council	3 wire	6 B. & W...	1 150 h.p., 2 350 h.p., 1 750 h.p., Willans	4 Johnson-Phillips	1 88 kw., 2 165 kw., 1 400 kw.	Direct ..	Non
(127) Stepney	Borough Council	3 wire at 240 v. and 480 v.	2 Babcock, Destrctr. blr. as reserve	1 200 i.h.p., 2 400 i.h.p., Willans..	Mather-Platt 4 pole	2 60 kw. in tandem on small engine, 2 275 kw. on large engs.	Direct ..	Non
(128) St. James's Parish	St. James's and Pall Mall Electric Light Co.	3 wire	Economic, loco., and water tube	6,000 h.p., Willans	Siemens	—	Direct ..	Non
(129) St. Martin's in the Fields, Strand Dist., S. Holborn, St. Giles, and the City of London	Charing Cross and Strand Electricity Supply Co.	3 wire	21 watr. t'be. 2 marine	6 1,320 h.p., Willans; 14 8,000 h.p. Belliss	Mather-Platt and Siemens ..	6 total 620 kw., 14 total 4,400 kw.	Direct ..	2,000 dens
(130) St. Pancras ..	Borough Council	3 wire, 110 and 220 v., 3 wire, 440 v.	Water tube, Lancs. and 3-flue mar.	18 5,280 i.h.p., Willans; 3 660 i.h.p., Belliss; 1 250 i.h.p., Peache	Kapp, Latimer, Siemens, and Crompton	50 to 500 kw.	Direct ..	Conde
(131) Sydenham	Crystal Palace District Electricity Supply Co., Ltd.	Sub-station motor trans. and batteries	3 Hornsby water tube	2 horiz. compound 40 h.p. nom., 1 80 i.h.p., Willans; 3 280 h.p., Belliss	E.C.C.	2 90 kw., 1 45 kw., 3 200 kw., at 1,000 v.	Rope and direct	Non

	driven boosters			arm'rd., laid direct in gr nd		88 8 c.p.				Long-Schattner		duce
Norwich	6 30 kw., 3 81 kw., 2 125 kw., 3 187 kw., 1 440 kw	Direct ..	Körting condenser to each engine	Bare copper in culverts, and B.I.W. cable	252 arcs, 29,630 16 c.p.	—	9,800 ..	5d.	—	Scott, Hookham, and Schattner	1,674	Coal ..

			arm'rd., laid direct in gr nd		88 8 c.p.				Long-Schattner		ducer gas						
w., Direct ..	Körting condenser to each engine	Bare copper in culverts, and B.I.W. cable	252 arcs, 29,630 16 c.p.	—	9,800 ..	5d.	—	Scott, Hookham, and Schattner	1,674	Coal	£65,456 (inc. site)	£49,554	7/9	Outlying districts	110 220
Direct ..	—	Callender.....	100,378 8 c.p.	15 arcs	14,378	Ltg. 5d. to 2d., power 1½d.	Brighton	Ferranti and Hookham	2,940	Coal	£166,098 (31st Mar., 1900)		4/10	—	200
300 Belt	Non-condensing	Overhead wires	1,000 16 c.p.	180 incand.	100	6d. and 8d.	Contract chiefly	Ferranti	850 amp.	Small coal	£5,565		8/9 and 12/6	None	100 115
w., Direct .. kw.	Condensing....	Bare strip & rub. & B.I.W. cabs. in iron pipes & bit. cabs. solid	40,000 8 c.p. (Jan., 1901)	28 arcs	—	4d. & 2d., str'et lighting 2½d.	Brighton (2 hours)	Ferranti	1,332	Slack coal	£41,201 (March,	£25,223 1900)	5/3½	All.....	210 105
w., Ropes and direct	Non-condensing	Callender armoured cables ..	4,600 8 c.p.	—	600	7d.	Brighton (2 hours)	Ferranti and Thomson	173	Coal	£7,100		3/4	All.....	220
w, Ropes, belt and direct kw.	Condensing....	H.T. i.r. cables in iron pipes L.T. Callender	30 arcs and 33,000 8 c.p.	32 arcs and 48 16 c.p.	3,700....	6d.	—	Hookham and Ferranti	855	Welsh coal	£71,000	£40,000	8/-	—	100
... Direct ..	Condensing....	Callender triple conc., solid system	3,084 8 c.p., 2 arc lps.	18 arcs, 200 16 c.p.	—	Lighting 6d., power 3d.	Discounts	Ferranti	300	Scotch nuts	£33,000	£10,170	—	—	220
... Direct ..	Condensing....	Callender distributors in casing, feeders solid	12 arcs, 3,380 8 c.p.	None	All.....	Lighting 6d., power 3d.	Flat rate	Ferranti	120	Derbyshire steam coal	£10,460	£4,055	—	—	200
, 1 Direct ..	Non-condensing	Copper strip, and Callender armoured	23 arcs, 5,608 8 c.p.	6 5 amp. arcs.	502	Lighting 6d., power 3d.	Flat rate	Ferranti and Hookham	161	Small coal	£3,741	£1,407	5/9	None	100
kw. Direct .. P., lt.	Condensing....	Bare strip in pipes, arm'rd H.P. conc., and Callender and lead covd. cable, solid	49,000 8 c.p.	42 arcs, 10 amps.	—	7d. and 4d., less 15 % for cash	Brighton	Ferranti and Hookham	1,986	Small slack	—	—	—	—	220
... Direct ..	Condensing....	Callender cable, v. bitumen ins., laid solid	1,850 incand.	15 arcs, 14 incand.	—	Ltg. 8d. & 3d., inc. free wir.	Wright's dem. ind.	Thomson	100	Sml. Welsh steam coal	—	—	—	All.....	230
... Direct ..	Condensing....	B.I.W., paper covd., triple conc.	4,360 8 c.p.	2,076 8 c.p.	All.....	Lighting 6d., power 3d.	Flat rate, 5 % for cash	Ferranti	545	Scotch slack and nuts	£28,577	£18,253	—	All.....	220
, 2 Direct ..	Non-condensing	Bare strip, Henley, Silvertown, and Glover cable	18,550 8 c.p.	—	4,239....	Lighting 6d., power 4d.	—	Ferranti and Aron	540	Welsh coal	£35,868	£23,998	9/-	None	110
Direct ..	Both	——	—	—	—	Ltg. 6d. & 4d., power 3d.	Brighton	Hookham	—	—	—	—	—	—	220
.. Belt and direct	Non-condensing	B.I.W., paper insulation lead covd. in pipes	1,000 8 c.p.	14 25 c.p. ..	50	6d.	—	Ferranti	—	Welsh coal	—	—	—	—	100
, 2 on w., w. —	Wright heater condenser	Callender 3 core distributors, T.C.C. feeders	9,647 8 c.p.	148 8 c.p...	3,567 ..	7d., 4d. and 2d.	Maximum demand	Ferranti, Hookham, and Schattner	250	Farringdon small coal.	£34,547	£8,890	6/3	All.....	210
.. Belt	—	Conc. lead covd. and arm'rd	1 arc, 4,000 incand.	None	1,000....	Contract 6d., free wir. 6½d.	By meter	Ferranti and Hookham	44	Anthracite peas	£7,500	£1,500	—	—	220
w., Direct ..	Non-condensing	Callender armoured cables ..	11,500	29 arcs, 13 fixing	3,106....	7d., 4d. and 2d.	Brighton	Thomson, Ferranti, and Hookham	* 299	Coal	—	—	7/3	All.....	210
w., Direct .. w., w.	Non-condensing	Bare strip, diatrine conc. for altern. mains	18,000 8 c.p.	62 arcs	7,337....	Lighting 6d., power 3d.	Brighton	Ferranti, Hookham, Aron, and Shallenberger	1,080	Small coal	£55,000		8/3	None	100 200
.. Rope ..	Jet condenser ..	Callender solid bit. system ..	8,558 8 c.p.	4 arcs	1,212....	Ltg. 5d., pwr. 2½d., 2d., spl 2½d. to 1½d.	—	Hook'm, Ferranti, and Thomson	198	Coke breeze coke, and rough slk.	£20,000	£4,000	4/2	5,000.....	105 210
v., Belts and counter shafting	Non-condensing	Parallel	3 arcs, 2,000 incand.	—	—	—	Rebate 6½d., 3½d.	Hookham	95	Coal	£6,000	—	—	—	100
w., Direct .. 15 C.	Condensing....	H.P. feeders., B.I.W. paper ins., L.P. single cables	68 arcs, 19,688 8 c.p.	35 arcs, 12 amp., 72 16 c.p.	7,293....	Lighting 4½d., power 2d.	Flat rate, 2½ % dis. on pwr.	Thomson, Hookham, and Aron	1,000	Slack thro' and thro'	Ltg. £21,500* tr. £17,800	£13,800	4/6	All.....	230
.. Direct ..	Non-condensing	Callender feeders, conc. and dist., triple conc. laid direct, arc, sin., sol. & arm., laid dir.	5,200.....	30 arcs, 21 16 c.p.	Supply as started, Mar. '00	Ltg. 6d. & dis., pr. 4d., 3d., 2d.	Discounts	Ferranti	198	Nuts and dross	—	—	—	—	230
.. Direct ..	Non-condensing	Armoured	—	36 arcs....	7,700....	5d. and 2½d.	Direct ..	Ferranti & Reason	450	Coke breeze	—	—	23/4 units	—	230
w. Direct coupled	Non-condensing	Con. & triple con., arm. bit. cbls. laid in wood troughs	4,800 8 c.p.	36 arcs....	—	Ltg. 6d. & 2½d., pwr. 5d. & 1d.	Max. dem.	Ferranti	350	Steam coal	£28,000	£11,000	—	All.....	230
v., Direct .. w.	Non-con.; Wh'el'r surf. con. & cool. tower	Bare strip, Silvertown, in c.i. pipes and Doulton casing, and Callender solid	48,500 8 c.p.	54 arcs * ..	—	Lighting 5d., power 2½d.	Bright'n & flat rate with dis.	Ferranti, Thomson, & Hookham	2,327	Small coal, Durham	£73,680	£48,446	5/1	About half total wired	110 220
.. Belt	—	Overhead.....	—	23 arcs....	—	—	—	—	—	—	—	—	—	—	—
.. Direct ..	Non-condensing	Callender triple conc. fdrs. 3 core dis., arm'd.	—	24 arcs, 100 incand.	3,500....	7d. and 4d.	Wright's max. dem.	Hookham, Aron, Reason, and Ferranti	168	Steam coal	—	—	—	—	210
.. Direct ..	Condensing....	H.P. con. rub., Callender v.b. solid, lead shethd. in i.p., L.P. Call., arm'rd, in grnd.	16,457 8 c.p.	19 arcs	3,844....	Ltg. 6d. & 2d., power 2½d. & 1d.	Brighton	Hookham	600	Slack	£24,800	£9,500	5/9	None	105 210
.. Direct ..	Condensers (Ledward)	I.R. cables in earth. pipes and lead cov. B.I.W., solid	12,000 8 c.p.	485 incand., 9 arcs	2,976....	5d., £6 per kw., power 2d.	Flat rate, etc.	Hookham, Ferranti, and Aron	210	Unwashed nuts	£23,885	£9,469	8/2	About 250	105 100
v. Direct ..	Condensing....	3 wire	6,500.....	—	—	7d. and 2d.	Demand indicator	Aron and Hookham	720	Slack.....	—	—	—	—	230
10 Direct coupled	Non-condensing	Tri. conc. feeders, 3 core dis.	10,000	—	6,228....	7d., 5d. and 2d.	Wright's	Ferranti	293·5	Welsh sm'ke less steam coal	£20,335	£6,280	3/6	2,705 lamps....	210
Direct ..	Non-condensing	Triple conc. armoured	30 arcs, 15,484 8 c.p.	290 16 c.p., 34 arcs	7,957 ..	Lighting 6½d., power 4d.	50 % reb. af. ern. 12s. 8 c.p. an.	Ferranti, Hookhm., Thomson, Aron, Bastian, Schattner	625	Powell Duffryn	£23,000	£21,400	—	2,300 8 c.p.	110 220
2 Rope and direct	Ledward ejector condensers	Callender solid	29,361 8 c.p., 2,584 power and heat	51 arcs	6,673 8 c.p. 1,817 pwr and heat	6d. and 3d.	Brighton	Ferranti, Hookh'm, Aron, & Bastian	2,000	Forge coal	£81,000	£27,000	7/6	4,000.....	220
.. Direct ..	Condensing....	Conc. feeders, triple conc. dist., laid direct	16,200 8 c.p.	50 arcs	16,200 (9 months)	7d. & 2d., 7d. & 1½d. ov. 1,500 u ½ yr., pwr. 1½d	Rebate ..	Hookham	420	Pea nuts ..	About £40,000	About £10,000	—	All.....	230
w. Direct ..	Non-condensing	——	—	15 arcs, 377 posts, 2 8 c.p.	—	Lighting 4½d., power 3½d.	Flat rate	Thomson, Bastian, Long-Schattner (prepay.)	240	Welsh coal	—	—	—	All.....	230
00 Direct ..	Non-condensing	Callender in stoneware casings	145,000 8 c.p.	—	16,000 ..	Ltg. 6d. to 3d., power 3d.	Brighton	Hookham	3,100	Welsh coal	—	—	—	Nearly ¾ of total	200
., Direct ..	Non-condensing	Overhead and underground..	—	—	—	6d. and 2½d.	Wright's	Hookh'm, Ferranti and Aron	650	Welsh smokeless	—	—	—	—	100
.. Direct ..	Ledward condensers	Ld. covd. B.I.W., rub. cables in iron pipes & bare strip in cul.	199,098 8 c.p.	—	16,636 ..	6d. at 100 v., 5d. at 200 v. power 4d.	Rebate ..	Aron, Ferranti, and Hookham	1,000	Welsh coal	£290,000 whole	system	6/-	142,363.....	200
rs. Direct .. ns	—	——	—	—	—	—	—	—	1,360	—	—	—	—	—	—
.. Direct ..	Non-condensing	B.I.W. cables and bare strip, in Doulton conduits	68,505 8 c.p.	—	9,351....	8d. at 100, 6d. at 200, 4d. day load	By meter	Aron, Ferranti, and Hookham	640	Welsh coal	£51,675	£95,684	6/5	About 90% of connections	100 200
v. Direct ..	Surface condensing	B.I.W. paper ins. cab. fdrs., 6 core dist., 5 core laid solid in earthenware troughs	9,300.....	3,300 8 c.p., 190 arcs	12,600 ..	Ltg. 5d., 4d. & 3d., pr. 3d. & 1½d.	Wright..	Ferranti and Schattner	790 with battery	Pea nuts ..	£43,000	£50,000	—	All.....	230 460
., Direct ..	Non-condensing	B.I.W. paper in Doulton conduits, rubber cables	—	240 arcs ..	—	Ltg. 5d. & 2d., m. d., 4½d. all r'nd, pwr. 2d. & 1½d.	Brighton	Ferranti and Hookham	1,450	Refuse and coal	—	—	—	None.....	150
v. Direct ..	Non-condensing	Bare copper and Callender bitumen	Equivalt. of 23,239 8 c.p.	—	6,279....	6d. to 3¾d.*	Sliding scale	Hookham	800	Welsh steam coal	—	—	13/6	1,500 8 c.p.	100 200
., Direct ..	Non-condensing	Lead covd. B.I.W. dist. laid solid, feeders lead covd. in conduits	18,352 8 c.p.	90 arcs, 180 32 c.p.	7,838* ..	6d., 4d. & 3d.; also discnts.	Maximum demand	Thomson	818	Pea size coking coal	£62,000	—	—	—	220
n Direct .. 2 gs.	Non-condensing	B.I.W. solid, 3 single mains	Equivalent 14,187 8 c.p.	70 arcs, 5 32 c.p. incand.	13,878 ..	8d. 1st hr., 1d. after	Wright's	Reason.....	798 (without spare)	Welsh	—	—	—	All.....	240
Direct ..	Non-condensing	Callender bitu., Siemens, bare copr., and B.I.W.	186,347 8 c.p.	61 arcs	21,597 ..	Ltg. 6d. to 4d., less 8 %, pwr. 3d.	1st 4,000 6d., aft. 4d., less 8 %	Hookham, Ferranti, Aron, and T. H.	3,880	Coal	—	—	9/8	—	107 214
4 Direct ..	2,000 h.p. condensing	Callender in casing, arm'rd and paper cables, B.I.W.	219,860 8 c.p.	113 arcs ..	39,431 ..	Lighting 6d., power 4d.	Sliding scale	Aron, Ferranti, and Hookham	5,020	Welsh coal	—	—	—	—	100 200
. Direct ..	Condensing....	Bare strip and armoured cable	141,681 8 c.p.	426 arcs ..	31,219 ..	Indictr. systm., 6d. & 2d., or 5d. all ro'nd	Brighton, optional	Aron, Hookham, Ferranti, and Thomson	3,690	Coal	£163,583 inclu. land	£173,222	6/1½	—	110 220
., Rope and v. direct	Non-condensing	B.I.W. lead covd. in ground, & Callender solid in trough-	30,000 8 c.p.	—	4,000....	6d., 5d. and	Rebate ..	Ferranti, Hookham,	825	Welsh coal	—	—	6/1	None	100

er		ducer gas						res. eng.				
am,	1,674	Coal	£65,456 (inc. site)	£49,554	7/9	Outlying districts	110 v. and 220 v.	130 = 573 h.p.	—	F. M. Long....	**Norwich** .....(83)	

(131) **Sydenham**	Crystal Palace District Electricity Supply Co., Ltd.	220 v., 3 wire, 440 v. Sub-station motor trans. and batteries	Lancs. and 3-flue mar. 3 Hornsby water tube	Belliss; 1 250 i.h.p., Peache 2 horiz. compound 40 h.p. nom., 1 80 i.h.p., Willans; 3 280 h.p., Belliss	Happ, Latimer, Siemens, and Crompton E.C.C.	50 to 500 kw. ..... 2 90 kw., 1 45 kw., 3 200 kw., at 1,000 v.	Direct .. Rope and direct	Cons Non-

		driven boosters			arm'rd., laid direct in gr nd		88 8 c.p.				Long-Schattner			duc
.p., 2 200 700 i.h.p.,	Norwich	6 30 kw., 3 81 kw., 2 125 kw., 3 187 kw., 1 440 kw.	Direct ..	Körting condenser to each engine	Bare copper in culverts, and B.I.W. cable	252 arcs, 29,630 16 c.p.	—	9,800 ..	5d.	—	Scott, Hookham, and Schattner	1,674	Coal	
4 360 h.p.,	Siemens	—	Direct ..	—	Callender.....	100,378 8 c.p.	15 arcs	14,378	Ltg. 5d. to 2d., power 1½d.	Brighton	Ferranti and Hookham	2,940	Coal	
.....	J. C. Howell	1 200 amps., 1 300 amps., 5 70 amps.	Belt	Non-condensing	Overhead wires	1,000 16 c.p.	180 incand.	100	6d. and 8d.	Contract chiefly	Ferranti	850 amp.	Small	
2 200 h.p.,	Charlesworth Hall and Siemens	2 36 kw., 2 60 kw., 2 120 kw., 4 225 kw.	Direct ..	Condensing....	Bare strip & rub. & B.I.W. cabs. in iron pipes & bit. cabs. solid	40,000 8 c.p. (Jan., 1901)	28 arcs	—	4d. & 2d., str'et lighting 2½d.	Brighton (2 hours)	Ferranti	1,332	Slack	
, 1 Scott-	2 Parker, 1 Siemens, 1 Scott-Mountain	2 30 kw., 1 33 kw., 1 80 kw.	Ropes and direct	Non-condensing	Callender armoured cables ..	4,600 8 c.p.	—	600	7d.	Brighton (2 hours)	Ferranti and Thomson	173	Coal	
o. 200 h.p., .p., Willans	E.C.C., 1,000 v.....	3 90 kw., 1 100 kw., 1 260 kw., 1 225 kw.	Ropes, belt and direct	Condensing....	H.T. i.r. cables in iron pipes L.T. Callender	30 arcs and 33,000 8 c.p.	32 arcs and 48 16 c.p.	3,700....	6d.	—	Hookham and Ferranti	855	Welsh	
nderson &	Fynn	4 75 kw.	Direct ..	Condensing....	Callender triple conc., solid system	3,084 8 c.p., 2 arc lps.	18 arcs, 200 16 c.p.	—	Lighting 6d., power 3d.	Discounts	Ferranti	300	Scotch	
.....	General Electric Co.....	2 60 kw.	Direct ..	Condensing....	Callender distributors in casing, feeders solid	12 arcs, 3,380 8 c.p.	None	All.....	Lighting 6d., power 3d.	Flat rate	Ferranti	120	Derby steam	
1 25 i h.p.,	Crompton and Parker	2 39 kw., 1 13 kw., 1 70 k.w.	Direct ..	Non-condensing	Copper strip, and Callender armoured	23 arcs, 5,608 8 c.p.	6 5 amp. arcs.	502	Lighting 6d., power 3d.	Flat rate	Ferranti and Hookham	161	Small	
h.p., 2 330 750 b.h.p.,	Westminster, Siemens, and E.C.C.	6 66, 2 225, 2 16·5 kw. mr.al., 2 510 kw. L.P., 2 70 kw. H.P., alt.	Direct ..	Condensing....	Bare strip in pipes, arm'rd H.P. conc., and Callender and lead covd. cable, solid	49,000 8 c.p.	42 arcs, 10 amps.	—	7d. and 4d., less 15 % for cash	Brighton	Ferranti and Hookham	1,986	Small	
.....	British Thomson-Houston ..	4 25 kw.	Direct ..	Condensing....	Callender cable, v. bitumen ins., laid solid	1,850 incand.	15 arcs, 14 incand.	—	Ltg. 8d. & 3d., inc. free wir.	Wright's dem. ind.	Thomson	100	Sml. V steam	
, Willans	4 Mather-Platt	2 75 kw., 2 150 kw...	Direct ..	Condensing....	B.I.W., paper covd., triple conc.	4,360 8 c.p.	2,076 8 c.p.	All.....	Lighting 6d., power 3d.	Flat rate, 5 % for cash	Ferranti	545	Scotch and	
2 200 h.p.,	Westminster and Mordey ..	3 67 kw., 2 45 kw., 2 130 kw., 220 v.	Direct ..	Non-condensing	Bare strip, Henley, Silvertown, and Glover cable	18,550 8 c.p.	—	4,239....	Lighting 6d., power 4d.	—	Ferranti and Aron	540	Welsh	
.....	Siemens	—	Direct ..	Both	——	—	—	—	Ltg. 6d. & 4d., power 3d.	Brighton	Hookham	—	—	
1 38 h.p.,	Flather and Silvertown	1 20 kw., 1 23 kw. ..	Belt and direct	Non-condensing	B.I.W., paper insulation lead covd. in pipes	1,000 8 c.p.	14 25 c.p. ..	50	6d.	—	Ferranti	—	Welsh	
kes; 1 120 220 i.h.p.,	Parker turbine, coupled by gearing & belting to balance set	2 boosters 5 kw., 2 dynamos 23 kw. on one shaft; 1 84 kw., 1 92 kw., 1 150 kw.	—	Wright heater condenser	Callender 3 core distributors, T.C.C. feeders	9,647 8 c.p.	148 8 c.p...	3,567 ..	7d., 4d. and 2d.	Maximum demand	Ferranti, Hookham, and Schattner	250	Farrin small	
Crossley..	2 pole	22 kw.	Belt	—	Conc. lead covd. and arm'rd	1 arc, 4,000 incand.	None	1,000....	Contract 6d., free wir. 6½d.	By meter	Ferranti and Hookham	44	Anthr	
.p., 1 350	Parker.....	3 33 kw., 2 100 kw., 1 240 kw.	Direct ..	Non-condensing	Callender armoured cables ..	11,500	29 arcs, 13 fixing	3,106....	7d., 4d. and 2d.	Brighton	Thomson, Ferranti, and Hookham	* 299	Coal .	
2 100 h.p., 1 500 h.p., Belliss	Crompton, 1 Schuckert, 300 kw.	3 120 kw., 2 100 kw., 1 90 kw., 2 60 kw., 1 30 kw., 1 60 kw. motor, 1 300 kw.	Direct ..	Non-condensing	Bare strip, diatrine conc. for altern. mains	18,000 8 c.p.	62 arcs	7,337....	Lighting 6d., power 3d.	Brighton	Ferranti, Hookham, Aron, and Shallenberger	1,080	Small	
.....	E.C.C.....	3 66 kw. each	Rope ..	Jet condenser ..	Callender solid bit. system ..	8,558 8 c.p.	4 arcs	1,212....	Ltg. 5d., pwr. 2½d., 2d., spl 2½d. to 1½d.	—	Hook'm, Ferranti, and Thomson	198	Coke b coke, rough	
.....	1 Crompton, 2 Kapp, 1 Veale	1 44 kw., 2 21 kw., 1 9 kw.	Belts and counter shafting	Non-condensing	Parallel	3 arcs, 2,000 incand.	—	—	—	Rebate 6½d., 3½d.	Hookham	95	Coal .	
illans	Johnson-Phillips alternators; Mather-Platt and Dick-Kerr, direct current	1 125 kw., 1 25 kw., A.C.; 2 125 kw., 2 215 kw., 1 320 kw., D.C.	Direct ..	Condensing....	H.P. feeders., B.I.W. paper ins., L.P. single cables	68 arcs, 19,688 8 c.p.	35 arcs, 12 amp., 72 16 c.p.	7,293....	Lighting 4½d., power 2d.	Flat rate, 2½ % dis. on pwr.	Thomson, Hookham, and Aron	1,000	Slack and t	
elliss	Mather-Platt, 4 pole	2 75 kw., 4 12 kw...	Direct ..	Non-condensing	Callender feeders, conc. and dist., triple conc. laid direct, arc, sin., sol. & arm., laid dir.	5,200.....	30 arcs, 21 16 c.p.	Supply as started, Mar. '00	Ltg. 6d. & dis., pr. 4d., 3d., 2d.	Discounts	Ferranti	198	Nuts a	
Villans....	McClure-Whitfield	56 and 140 units....	Direct ..	Non-condensing	Armoured	—	36 arcs....	7,700....	5d. and 2½d.	Direct ..	Ferranti & Reason	450	Coke b	
.....	Brush multi-polar.....	2 150 kw., 2 25 kw.	Direct coupled	Non-condensing	Con. & triple con., arm. bit. cbls. laid in wood troughs	4,800 8 c.p.	36 arcs....	—	Ltg. 6d. & 2½d., pwr. 5d. & 1d.	Max. dem.	Ferranti	350	Steam	
, Belliss;	Holmes, Parker, Crompton, Sunderland Forge & Silvertown	2 26 kw., 5 125 kw., 6 275 kw., 2 38 kw.	Direct ..	Non-con.; Wh'el'r surf. con. & cool. tower	Bare strip, Silvertown, in c.i. pipes and Doulton casing, and Callender solid	48,500 8 c.p.	54 arcs * ..	—	Lighting 5d., power 2½d.	Bright'n & flat rate with dis.	Ferranti, Thomson, & Hookham	2,327	Small Durh	
	Brush, driven by power supplied from Rother Vale Col'ry	14 kw.	Belt	—	Overhead.....	—	23 arcs....	—	—	—	—	—	—	
.....	Parker	84 kw.	Direct ..	Non-condensing	Callender triple conc. fdrs. 3 core dis., arm'd.	—	24 arcs, 100 incand.	3,500....	7d. and 4d.	Wright's max. dem.	Hookham, Aron, Reason, and Ferranti	168	Steam	
2 vertical	Parker	3 80 kw., 2 180 kw...	Direct ..	Condensing....	H.P. con. rub., Callender v.b. solid, lead shethd. in i.p., L.P. Call., arm'rd, in grnd.	16,457 8 c.p.	19 arcs	3,844....	Ltg. 6d. & 2d., power 2½d. & 1d.	Brighton	Hookham	600	Slack	
.....	Crompton	35 kw.	Direct ..	Condensers (Ledward)	I.R. cables in earth. pipes and lead cov. B.I.W., solid	12,000 8 c.p.	485 incand., 9 arcs	2,976....	5d., £6 per kw., power 2d.	Flat rate, etc.	Hookham, Ferranti, and Aron	210	Unwas	
, Willans	G. E. multipolar	2 150 kw., 2 210 kw.	Direct ..	Condensing....	3 wire	6,500.....	—	—	7d. and 2d.	Demand indicator	Aron and Hookham	720	Slack.	
elliss	Parker	2 115 amps., 1 410 amps.	Direct coupled	Non-condensing	Tri. conc. feeders, 3 core dis.	10,000	—	6,228....	7d., 5d. and 2d.	Wright's	Ferranti	293·5	Welsh s less s coal	
h.p., 1 160 h.p., Belliss	Siemens	—	Direct ..	Non-condensing	Triple conc. armoured	30 arcs, 15,484 8 c.p.	290 16 c.p., 34 arcs	7,957 ..	Lighting 6½d., power 4d.	50 % reb. af. ern. 12s. 8 c.p. an.	Ferranti, Hookhm., Thomson, Aron, Bastian, Schattner	625	Powell Du	
1 200 h.p.,	E.C.C. and Parker	4 140 kw., 1 70 kw., 2 220 kw., 2 500 kw.	Rope and direct	Ledward ejector condensers	Callender solid	29,361 8 c.p.. 2,584 power and heat	51 arcs	6,673 8 c.p. 1,817 pwr and heat	6d. and 3d.	Brighton	Ferranti, Hookh'm, Aron, & Bastian	2,000	Forge	
.....	Crompton	4 75 kw., 2 220 kw...	Direct ..	Condensing....	Conc. feeders, triple conc. dist., laid direct	16,200 8 c.p.	50 arcs	16,200 (9 months)	7d. & 2d., 7d. & 1½d. ov. 1,500 u ½ yr., pwr. 1½d	Rebate ..	Hookham	420	Pea nu	
Sunderland	Sunderland Forge Co.....	2 20 kw., 2 100 kw.	Direct ..	Non-condensing	——	—	15 arcs, 377 posts, 2 8 c.p.	—	Lighting 4½d., power 3½d.	Flat rate	Thomson, Bastian, Long-Schattner (prepay.)	240	Welsh	
.....	E.C.C.	80 kw., 150 kw., 200 kw., 400 kw.	Direct ..	Non-condensing	Callender in stoneware casings	145,000 8 c.p.	—	16,000 ..	Ltg. 6d. to 3d., power 3d.	Brighton	Hookham	3,100	Welsh	
illans	Siemens, Holmes, Crompton, Latimer Clark, E.C.C.	6 50 kw., 2 100 kw., 1 150 kw.	Direct ..	Non-condensing	Overhead and underground..	—	—	—	6d. and 2½d.	Wright's	Hookh'm, Ferranti and Aron	650	Welsh smok	
, 2 80 h.p.,	Siemens and Crompton	50 and 150 kw.	Direct ..	Ledward condensers	Ld. covd. B.I.W., rub. cables in iron pipes & bare strip in cul.	199,098 8 c.p.	—	16,636 ..	6d. at 100 v., 5d. at 200 v. power 4d.	Rebate ..	Aron, Ferranti, and Hookham	1,000	Welsh	
3 300 kw.,	——	5,000 v. 3 phase mtrs. driving 200 v. dyms	Direct ..	—	——	—	—	—	—	—	—	1,360	—	
.....	Crompton and Siemens	120 and 200 kw.....	Direct ..	Non-condensing	B.I.W. cables and bare strip, in Doulton conduits	68,505 8 c.p.	—	9,351....	8d. at 100, 6d. at 200, 4d. day load	By meter	Aron, Ferranti, and Hookham	640	Welsh	
, Belliss..	Mather-Platt	2 250 kw., 2 125 kw.	Direct ..	Surface condensing	B.I.W. paper ins. cab. fdrs., 6 core dist., 5 core laid solid in earthenware troughs	9,300.....	3,300 8 c.p., 190 arcs	12,600 ..	Ltg. 5d., 4d. & 3d., pr. 3d. & 1½d.	Wright..	Ferranti and Schattner	790 with battery	Pea nu	
, Willans;	E.C.C.	3 165 kw., 3 70 kw., 3 250 kw.	Direct ..	Non-condensing	B.I.W. paper in Doulton conduits, rubber cables	—	240 arcs ..	—	Ltg. 5d. & 2d., m. d., 4½d. all r'nd, pwr. 2d. & 1½d.	Brighton	Ferranti and Hookham	1,450	Refuse coal	
1 800 h.p.,	4 E.C.C., 1 Parker	4 125 kw., 1 200 kw.	Direct ..	Non-condensing	Bare copper and Callender bitumen	Equivalt. of 23,289 8 c.p.	—	6,279....	6d. to 3¾d.*	Sliding scale	Hookham	800	Welsh coal	
1 750 h.p.,	4 Johnson-Phillips	1 88 kw., 2 165 kw., 1 400 kw.	Direct ..	Non-condensing	Lead covd. B.I.W. dist. laid solid, feeders lead covd. in conduits	18,352 8 c.p.	90 arcs, 180 32 c.p.	7,838* ..	6d., 4d. & 3d.; also discnts.	Maximum demand	Thomson	818	Pea si coking	
, Willans..	Mather-Platt 4 pole	2 60 kw. in tandem on small engine, 2 275 kw. on large engs.	Direct ..	Non-condensing	B.I.W. solid, 3 single mains	Equivalent 14,187 8 c.p.	70 arcs, 5 32 c.p. incand.	13,878 ..	8d. 1st hr., 1d. after	Wright's	Reason.....	798 (without spare)	Welsh	
.....	Siemens	—	Direct ..	Non-condensing	Callender bitu., Siemens, bare copr., and B.I.W.	186,347 8 c.p.	61 arcs	21,597 ..	Ltg. 6d. to 4d., less 8 %, pwr. 3d.	1st 4,000 6d., aft. 4d., less 8 %	Hookham, Ferranti, Aron, and T. H.	3,880	Coal ..	
4 8,000 h.p.	Mather-Platt and Siemens ..	6 total 620 kw., 14 total 4,400 kw.	Direct ..	2,000 h.p. condensing	Callender in casing, arm'rd and paper cables, B.I.W.	219,860 8 c.p.	113 arcs ..	39,431 ..	Lighting 6d., power 4d.	Sliding scale	Aron, Ferranti, and Hookham	5,020	Welsh	
3 660 i.h.p., Peache	Kapp, Latimer, Siemens, and Crompton	50 to 500 kw.	Direct ..	Condensing....	Bare strip and armoured cable	141,681 8 c.p.	426 arcs ..	31,219 ..	Indictr. systm., 6d. & 2d., or 5d. all ro'nd	Brighton, optional	Aron, Hookham, Ferranti, and Thomson	3,690	Coal ..	
h.p. nom., 3 280 h.p.,	E.C.C.....	2 90 kw., 1 45 kw., 3 200 kw., at 1,000 v.	Ropes and direct	Non-condensing	B.I.W. lead covd. in ground, & Callender solid in troughing	30,000 8 c.p.	—	4,000....	6d., 5d. and 4½d.	Rebate ..	Ferranti, Hookham, and Aron	825	Welsh	
.....	E.C.C., Crompton, Siemens,	Up to 295 kw.	Direct ..	Non-condensing	Armoured strip and casing	—	12 arcs	48,144	Lighting 6d.	Rebates	Aron, Ferranti, ..	7[illegible]	Welsh	

	Direct ..	Condensing....	Bare strip and armoured cable	141,6818 c.p.	426 arcs ..	31,219 ..	Indictr. systm., 6d. & 2d., or 5d. all ro'nd	Brighton, optional	Aron, Hookham, Ferranti, and Thomson	3,690	Coal	£163,583 inclu. land	£173,222	6/1½		
., v.	Rope and direct	Non-condensing	B.I.W. lead covd. in ground, & Callender solid in trough-	30,000 8 c.p.	—	4,000....	6d., 5d. and 4½d.	Rebate ..	Ferranti, Hookham,	825	Welsh coal	—	—	6/1	None	

er		ducer gas								res. eng.	
am,	1,674	Coal	£65,456 (inc. site)	£49,554	7/9	Outlying districts	110 v. and 220 v.	130 = 573 h.p.	—	F. M. Long....	**Norwich** .....(83)
	2,940	Coal	£166,098 (31st Mar., 1900)		4/10	—	200 v.....	130 = 470 h.p.	—	H. Talbot	**Nottingham**....(84)
am ...	850 amp.	Small coal	£5,565		8/9 and 12/6	None	100 v. to 115 v.	70 h.p.	—	—	**Ogmore Valley** †(85)
...	1,332	Slack coal	£41,201 (March, 1900)	£25,223	5/3½	All.....	210 v. and 105 v.	26 h.p.	—	S. Wilmott Newington	**Oldham** .....(86)
son	173	Coal	£7,100		3/4	All.....	220 v.	2 3 h.p. each ..	—	E. Bremner Smith	**Oswestry** .....(87)
nti	855	Welsh coal	£71,000	£40,000	8/–	—	100 v.	25 h.p.	—	Percy J. Rea ..	**Oxford** .....(88)
...	300	Scotch nuts	£33,000	£10,170	—	—	220 v.	7 h.p.	Supply commenced June, 1900	S. L. R. Price..	**Pembroke (Ireland)** (89)
...	120	Derbyshire steam coal	£18,460	£4,055	—	—	200 v.	3 2 h.p.....	Supply commenced Dec., 1900	John C. Gill ..	**Peterborough**..(90)
am	161	Small coal	£8,741	£1,407	5/9	None	100 v.	2 = ½ h.p.	—	G. A. Maquay..	**Pontypool** .....(91)
ook-	1,986	Small slack	—	—	—	—	220 v.	—	—	J. H. Tonge ..	**Preston** .....(92)
...	100	Sml. Welsh steam coal	—	—	—	All.....	230 v.	None	Tudor battery, 280 amp. hours. First year of working	C. H. Merz, eng., H. Nalder, res. eng.	**Queenstown**....(93)
..	545	Scotch slack and nuts	£28,577	£18,253	—	All.....	220 v.	1 = 4 h.p.	—	G. F. Pilditch..	**Rathmines** ....(94)
ron	540	Welsh coal	£35,868	£23,998	9/-	None	110 v.	—	—	M. C. Flemyng	**Richmond (Surrey)** (95)
..	—	—	—	—	—	—	220 v.	—	Supply commenced Oct., 1900	C. C. Atchison	**Rochdale** .....(96)
..	—	Welsh coal	—	—	—	—	100 v.	1 = 1 h.p.	—	A. Jupp	**Rottingdean**....(97)
am,	250	Farringdon small coal.	£34,547	£8,890	6/3	All.....	210 v.	11 = 40½ h.p...	—	A. B. Randall..	**Salisbury** .....(98)
am	44	Anthracite peas	£7,500	£1,500	—	—	220 v.	7 = 13 h p.	2 80 b.h.p. Dowson gas generators	F. J. Robinson..	**Saltburn-by-the-Sea** (99)
nti,	* 299	Coal	—	—	7/3	All.....	210 v.	40 b.h.p.	* With extensions in progress 540 kw.	C. M. Johnston	**Shrewsbury** ..(100)
k- nd	1,080	Small coal	£55,000		8/3	None	100 v. and 200 v.	35 = 160 h.p. ..	—	F. H. Chaplin	**Southampton** ‡ (101)
ti,	198	Coke breeze coke, and rough slk.	£20,000	£4,000	4/2	5,000.....	105 v. and 210 v.	34½ h.p.	—	H. Pooley	**Stafford** .....(102)
..	95	Coal	£6,000	—	—	—	100 v.	14 = 14½ h.p. ..	—	J. M. Coon	**St. Austell** ....(103)
k-	1,000	Slack thro' and thro'	Ltg. £21,500* tr. £17,800	£13,800	4/6	All.....	230 v.	38 = 180 h.p. ..	Combined ltg. and tr. sys. Chlor. batt. *This also incl. cap. on old A.C. sta.	J. S. Highfield..	**St. Helens** ....(104)
..	198	Nuts and dross	—	—	—	—	230 v.	10 = 7 h.p.....	First year of working. Extensions on order, 2 360 h.p. sets	A. C. Hanson..	**Stirling**.....(105)
on	450	Coke breeze	—	—	23/4 units	—	230 v.	1 = 80 h.p., 1 = 4 h.p.	—	S. Meunier, A. J. H. Carter, (electrical man.)	**Stockport** ....(106)
..	350	Steam coal	£28,000	£11,000	—	All.....	230 v.	4 = 6½ h.p.....	—	J. J. Smith. Wm. Ford, genl. mnger.	**Stockton-on-Tees** (107)
on,	2,327	Small coal, Durham	£73,680	£48,446	5/1	About half total wired	110 v. and 220 v.	560 h.p.	* 100 arcs to be added ..	John F. C. Snell	**Sunderland**....(108)
	—	—	—	—	—	—	—	—	—	Wm. H. Barwell	**Treeton**.....(109)
n,	168	Steam coal	—	—	—	—	210 v.	10 = 13 h.p. ..	—	A. E. Mayes....	**Ventnor**.....(110)
ti ..	600	Slack	£24,800	£9,500	5/9	None	105 v. and 210 v.	31 = 65 h.p. ..	—	A. Wyllie	**Walsall** .....(111)
ti,	210	Unwashed nuts	£23,885	£9,469	8/2	About 250	105 v. and 100 v.	2 = 13 h.p.....	—	E. W. Dunton	**Whitehaven** ..(112)
m	720	Slack.....	—	—	—	—	230 v.	60 kw.	—	H. Collings Bishop	**Wigan** .....(113)
..	293·5	Welsh sm'ke less steam coal	£20,335	£6,280	3/6	2,705 lamps....	210 v.	2 = 6 h.p.	—	H. N. Warburton	**Winchester** † ..(114)
n., on, ner	625	Powell Duffryn	£23,000	£21,400	—	2,300 8 c.p.	110 v. and 220 v.	32·5 h.p.	Wright's max. demand being introduced	A. E. Farrow ..	**Windsor** .....(115)
m, n	2,000	Forge coal	£81,000	£27,000	7/6	4,000.....	220 v.	22 = 87½ e.h.p...	—	C. E. C. Shawfield	**Wolverhampton** (116)
..	420	Pea nuts ..	About £40,000	About £10,000	—	All.....	230 v.	Several on order	Plant not all installed yet. Sup. com. April, 1900. Further exten. contem.	C. H. Midgley..	**York** .....(117)
											LONDON.
n, r .)	240	Welsh coal	—	—	—	All.....	230 v.	17 h.p.	—	A. Hugh Seabrook	**Barking** .....(118)
..	3,100	Welsh coal	—	—	—	Nearly ¾ of total	200 v.	—	—	Percy Still	**Chelsea** .....(119)
nti	650	Welsh smokeless	—	—	—	—	100 v. to 110 v.	—	—	H. J. Brownrigg	**Hampstead**....(120)
nd	1,000	Welsh coal	£290,000 whole	system	6/–	142,363.....	200 v.	22 = 85 h.p. ..	Albert Vaults transformer station supplied from Wood Lane works and feeding into general network	H. W. Miller..	**Kensington**....(121)
	1,360	—	—	—	—	—	—	—			
m	640	Welsh coal	£51,675	£95,684	6/5	About 90% of connections	100 v. and 200 v.	21 h.p.	—	Geo. Schultz ..	**Notting Hill** ..(122)
er	790 with battery	Pea nuts ..	£43,000	£50,000	—	All.....	230 v. and 460 v.	4 = 45 h.p.....	Supply commenced Oct., 1900	Alfred Blackman	**Poplar** .....(123)
m	1,450	Refuse and coal	—	—	—	None.....	150 v.	About 900 b.h.p.	—	C. Newton Russell	**Shoreditch** ....(124)
..	800	Welsh steam coal	—	—	13/6	1,500 8 c.p.	100 v. and 200 v.	—	* Price inclu. free wiring, mainten., clng. & renewals	Eustace Ridley	**Smithfield Markets** (125)
..	818	Pea size coking coal	£62,000	—	—	—	220 v.	Equiv. of 1,341 8 c.p.	*March, 1900, to January, 1901	J. R. Blaikie ..	**Southwark** ....(126)
..	798 (without spare)	Welsh	—	—	—	All.....	240 v.	23 = 114 h.p...	—	A. Wright, consult. W. C. P. Tapper, resident	**Stepney** .....(127)
r- d	3,880	Coal	—	—	9/8	—	107 v. and 214 v.	—	—	Sydney T. Dobson	**St. James's Parish** (128)
i,	5,020	Welsh coal	—	—	—	—	100 v. and 200 v.	—	Work under the City of London Order, 1899, in hand	W. H. Patchell	**St. Martin's in the Fields, Strand District. S. Holborn, St. Giles, and the City of London** (129)
n,	3,690	Coal	£163,583 inclu. land	£173,222	6/1½	—	110 v. and 220 v.	136 = 516 h.p.	—	S. W. Baynes..	**St. Pancras**....(130)
n,	825	Welsh coal	—	—	6/1	None.....	100 v.	3 = 100 h.p. ..	—	A. L. Phillips..	**Sydenham** ....(131)
	7	Welsh			6/2	All					

2,100 kw	Direct	Non-condensing	Bare strip, distrine conc. for	12,000 8	60	7,227	Lighting &	Brighton	Ferranti,	Hook	1,000

(101) Southampton ‡	Corporation	3 wire, 100 and 200 v., and alterg. trans. 2,000 to 200	1 Lancs., 6 Babcock	3 180 h.p., 2 150 h.p., 2 100 h.p., 1 60 h.p., Willans; 1 500 h.p., Ferranti; 1 140 h.p., Belliss	Crompton, 1 Schuckert, 300 kw.	3 120 kw., 2 100 kw., 1 90 kw., 2 60 kw., 1 30 kw., 1 60 kw. motor, 1 300 kw.	Direc
(102) Stafford	Corporation	3 wire	3 Lancs.	3 Marshall	E.C.C.	3 66 kw. each	Rope
(103) St. Austell	Veale & Co.	2 wire	Loco. type	3 compound	1 Crompton, 2 Kapp, 1 Veale	1 44 kw., 2 21 kw., 1 9 kw.	Belts coun shaft
(104) St. Helens	Corporation	Sub-stations A.C., 3 wire D.C.	2 Lcs. A.C., 4 Lcs., 2 B. & W., D.C.	A.C., Robey; D.C., Willans	Johnson-Phillips alternators; Mather-Platt and Dick-Kerr, direct current	1 125 kw., 1 25 kw., A.C.; 2 125 kw., 2 215 kw., 1 320 kw., D.C.	Direct
(105) Stirling	Town Council	3 wire	2 Lancs.	2 120 h.p., 2 40 h.p., Belliss	Mather-Platt, 4 pole	2 75 kw., 4 12 kw.	Direct
(106) Stockport	Corporation	3 wire	2 Lancs., 2 B. & W.	3 90 h.p., 2 240 h.p., Willans	McClure-Whitfield	56 and 140 units	Direct
(107) Stockton-on-Tees	Corporation	3 wire	3 Galloway	3 Universal	Brush multi-polar	2 150 kw., 2 25 kw.	Direct coup
(108) Sunderland	Corporation	3 wire, 110 v., 2 wire, 220 v.	6 Lancs., 2 water tube, 4 Galloway	6 450 h.p., 5 200 h.p., Belliss; 2 50 h.p., Willans	Holmes, Parker, Crompton, Sunderland Forge & Silvertown	2 26 kw., 5 125 kw., 6 275 kw., 2 38 kw.	Direct
(109) Treeton	Parish Council	Series	—	—	Brush, driven by power supplied from Rother Vale Col'ry	14 kw.	Belt
(110) Ventnor	Isle of Wight Electric Light and Power Co.	3 wire	B. & W.	2 110 b.h.p., Belliss	Parker	84 kw.	Direct
(111) Walsall	Corporation	Sub-station motor transformers	2 Lancs., 2 water tube	3 vertical 125 i.h.p., 2 vertical 300 i.h.p.	Parker	3 80 kw., 2 180 kw.	Direct
(112) Whitehaven	Corporation	3 wire	Lancs.	6 60 h.p., Willans	Crompton	35 kw.	Direct
(113) Wigan	Corporation	3 wire	B. & W.	2 250 i.h.p., 2 300 i.h.p., Willans	G. E. multipolar	2 150 kw., 2 210 kw.	Direct
(114) Winchester †	Electric Lighting Co.	3 wire	3 Babcock	2 80 h.p., 1 300 h.p., Belliss	Parker	2 115 amps., 1 410 amps.	Direct coup
(115) Windsor	Windsor Electric Installation Co., Ltd.	3 wire	2 Lancs., 3 economic	2 200 i.h.p., 1 100 i.h.p., 1 160 i.h.p., Peache; 1 400 i.h.p., Belliss	Siemens	—	Direct
(116) Wolverhampton	Corporation	Sub-stn. mot. trans., and 3 wire	Lancs.	3 250 h.p., 1 120 h.p., 1 200 h.p., 2 350 h.p., 2 800 h.p.	E.C.C. and Parker	4 140 kw., 1 70 kw., 2 220 kw., 2 500 kw.	Rope a direct
(117) York	Corporation	3 wire	2 Lancs., 2 B. & W.	4 130 h.p., 2 260 h.p.	Crompton	4 75 kw., 2 220 kw.	Direct
LONDON.							
(118) Barking	Urban District Council	3 wire	B. & W.	1 60 h.p., 2 130 h.p., Sunderland Forge Co.	Sunderland Forge Co.	2 20 kw., 2 100 kw.	Direct
(119) Chelsea	Chelsea Electricity Supply Co.	3 wire	Water tube	Willans	E.C.C.	80 kw., 150 kw., 200 kw., 400 kw.	Direct
(120) Hampstead	Hampstead Electric Supply Co., Ltd.	2 wire	5 B. & W.	3 200 h.p., 6 80 h.p., Willans	Siemens, Holmes, Crompton, Latimer Clark, E.C.C.	6 50 kw., 2 100 kw., 1 150 kw.	Direct
(121) Kensington	Kensington and Knightsbridge Electric Lighting Co.	3 wire	6 B. & W.	9 1,910 h.p., 7 250 h.p., 2 80 h.p., Willans	Siemens and Crompton	50 and 150 kw.	Direct
				1 100 kw., 2 180 kw., 3 300 kw., motor generators	—	5,000 v. 3 phase mtrs. driving 200 v. dyms	Direct
(122) Notting Hill	Notting Hill Electric Lighting Co.	3 wire	Water tube	Willans	Crompton and Siemens	120 and 200 kw.	Direct
(123) Poplar	Borough Council	3 wire, 460 v. across outers	4 B. & W.	2 400 i.h.p., 2 200 i.h.p., Belliss	Mather-Platt	2 250 kw., 2 125 kw.	Direct
(124) Shoreditch	Borough Council	Sub-station motor trans.	Dust destrs. wtr. t'be bls., & semi-mar.	3 300 i.h.p., 3 150 i.h.p., Willans; 3 500 i.h.p., Belliss	E.C.C.	3 165 kw., 3 70 kw., 3 250 kw.	Direct
(125) Smithfield Markets	Smithfield Markets Electricity Supply Co.	3 wire	5 economic	4 250 h.p., Windsor; 1 300 h.p., Belliss	4 E.C.C., 1 Parker	4 125 kw., 1 200 kw.	Direct
(126) Southwark	Borough Council	3 wire	6 B. & W.	1 150 h.p., 2 350 h.p., 1 750 h.p., Willans	4 Johnson-Phillips	1 88 kw., 2 165 kw., 1 400 kw.	Direct
(127) Stepney	Borough Council	3 wire at 240 v. and 480 v.	2 Babcock, Destrctr. blr. as reserve	1 200 i.h.p., 2 400 i.h.p., Willans	Mather-Platt 4 pole	2 60 kw. in tandem on small engine, 2 275 kw. on large engs.	Direct
(128) St. James's Parish	St. James's and Pall Mall Electric Light Co.	3 wire	Economic, loco., and water tube	6,000 h.p., Willans	Siemens	—	Direct
(129) St. Martin's in the Fields, Strand Dist., S. Holborn, St. Giles, and the City of London	Charing Cross and Strand Electricity Supply Co.	3 wire	21 watr. t'be. 2 marine	6 1,320 h.p., Willans; 14 8,000 h.p. Belliss	Mather-Platt and Siemens	6 total 620 kw., 14 total 4,400 kw.	Direct
(130) St. Pancras	Borough Council	3 wire, 110 and 220 v., 3 wire, 440 v.	Water tube, Lancs. and 3-flue mar.	18 5,280 i.h.p., Willans; 3 660 i.h.p., Belliss; 1 250 i.h.p., Peache	Kapp, Latimer, Siemens, and Crompton	50 to 500 kw.	Direct
(131) Sydenham	Crystal Palace District Electricity Supply Co., Ltd.	Sub-station motor trans. and batteries	3 Hornsby water tube	2 horiz. compound 40 h.p. nom., 1 80 i.h.p., Willans; 3 280 h.p., Belliss	E.C.C.	2 90 kw., 1 45 kw., 3 200 kw., at 1,000 v.	Ropes a direct
(132) Westminster and St. George's	Westminster Electricity Supply Corporation, Ltd.	3 wire	Paxman and Babcock	Willans, up to 361 i.h.p.	E.C.C., Crompton, Siemens, and Goolden	Up to 225 kw.	Direct
(133) Woolwich	Woolwich District Electric Light Co.	—	4 loco., 4 economic	2 100 kw., 1 250 kw., Parsons trbns.; 1 100 kw., Allen; 1 110 kw., Bumstead-Chandler	Parsons, Allen, Easton-Anderson-Goolden	3 110 kw., 1 100 kw., 1 250 kw.	Direct a belts

‡ Employing both Alternating and Continuous Current.
† No Return to hand.

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(Late Fowler Waring Cables Co.),

NORTH WOOLWICH, E.;

CHICAGO, ANTWERP, NEW YORK, BERLIN, PARIS, ETC.

, 2 100 kw., , 2 60 kw., , 1 60 kw. 1 300 kw.	Direct ..	Non-condensing	Bare strip, diatrine conc. for altern. mains	18,000 8 c.p.	62 arcs	7,337....	Lighting 6d., power 3d.	Brighton	Ferranti, Hookham, Aron, and Shallenberger	1,080	Small coal	£55,000		8/3	None	
each	Rope ..	Jet condenser ..	Callender solid bit. system ..	8,558 8 c.p.	4 arcs	1,212....	Ltg. 5d., pwr. 2½d., 2d., spl 2½d. to 1½d.	—	Hook'm, Ferranti, and Thomson	198	Coke breeze coke, and rough slk.	£20,000	£4,000	4/2	5,000.....	
, 2 21 kw.,	Belts and counter shafting	Non-condensing	Parallel	3 arcs, 2,000 incand.	—	—	—	Rebate 6½d., 3½d.	Hookham	95	Coal	£6,000	—	—	—	
, 1 25 kw., 25 kw., 2 215 0 kw., D.C.	Direct ..	Condensing....	H.P. feeders., B.I.W. paper ins., L.P. single cables	68 arcs, 19,688 8 c.p.	35 arcs, 12 amp., 72 16 c.p.	7,293....	Lighting 4½d., power 2d.	Flat rate, 2½ % dis. on pwr.	Thomson, Hookham, and Aron	1,000	Slack thro' and thro'	Ltg. £21,500* tr. £17,800	£13,800	4/6	All.....	
4 12 kw...	Direct ..	Non-condensing	Callender feeders, conc. and dist., triple conc. laid direct, arc, sin., sol. & arm., laid dir.	5,200.....	30 arcs, 21 16 c.p.	Supply as started, Mar. '00	Ltg. 6d. & dis., pr. 4d., 3d., 2d.	Discounts	Ferranti	198	Nuts and dross	—	—	—	—	
0 units....	Direct ..	Non-condensing	Armoured	—	36 arcs....	7,700....	5d. and 2½d.	Direct ..	Ferranti & Reason	450	Coke breeze	—	—	23/4 units	—	
., 2 25 kw.	Direct coupled	Non-condensing	Con. & triple con., arm. bit. cbls. laid in wood troughs	4,800 8 c.p.	36 arcs....	—	Ltg. 6d. & 2½d., pwr. 5d. & 1d.	Max. dem.	Ferranti	350	Steam coal	£28,000	£11,000	—	All.....	
5 125 kw., ., 2 38 kw.	Direct ..	Non-con.; Wh'el'r surf. con. & cool. tower	Bare strip, Silvertown, in c.i. pipes and Doulton casing, and Callender solid	48,500 8 c.p.	54 arcs * ..	—	Lighting 5d., power 2½d.	Bright'n & flat rate with dis.	Ferranti, Thomson, & Hookham	2,327	Small coal, Durham	£73,660	£48,446	5/1	About half total wired	
.....	Belt	—	Overhead.....	—	23 arcs....	—	—	—	—	—	—	—	—	—	—	
.....	Direct ..	Non-condensing	Callender triple conc. fdrs. 3 core dis., arm'd.	—	24 arcs, 100 incand.	3,500....	7d. and 4d.	Wright's max. dem.	Hookham, Aron, Reason, and Ferranti	168	Steam coal	—	—	—	—	
180 kw...	Direct ..	Condensing....	H.P. con. rub., Callender v.b. solid, lead shethd. in i.p., L.P. Call., arm'rd, in grnd.	16,457 8 c p.	19 arcs	3,844....	Ltg. 6d. & 2d., power 2½d. & 1d.	Brighton	Hookham	600	Slack	£24,800	£9,500	5/9	None	
.....	Direct ..	Condensers (Ledward)	I.R. cables in earth. pipes and lead cov. B.I.W., solid	12,000 8 c.p.	485 incand., 9 arcs	2,976....	5d., £6 per kw., power 2d.	Flat rate, etc.	Hookham, Ferranti, and Aron	210	Unwashed nuts	£23,885	£9,469	8/2	About 250	
2 210 kw.	Direct ..	Condensing....	3 wire	6,500.....	—	—	7d. and 2d.	Demand indicator	Aron and Hookham	720	Slack.....	—	—	—	—	
ps., 1 410	Direct coupled	Non-condensing	Tri. conc. feeders, 3 core dis.	10,000	—	6,228....	7d., 5d. and 2d.	Wright's	Ferranti	293·5	Welsh sm'keless steam coal	£20,335	£6,280	3/6	2,705 lamps....	
—	Direct ..	Non-condensing	Triple conc. armoured	30 arcs, 15,484 8 c.p.	290 16 c.p., 34 arcs	7,957 ..	Lighting 6½d., power 4d.	50 % reb. af. ern. 12s. 8 c.p. an.	Ferranti, Hookhm., Thomson, Aron, Bastian, Schattner	625	Powell Duffryn	£23,000	£21,400	—	2,300 8 c.p.	
170 kw., 2 2 500 kw.	Rope and direct	Ledward ejector condensers	Callender solid	29,361 8 c.p., 2,584 power and heat	51 arcs	6,673 8 c.p. 1,817 pwr and heat	6d. and 3d.	Brighton	Ferranti, Hookh'm, Aron, & Bastian	2,000	Forge coal	£81,000	£27,000	7/6	4,000.....	
220 kw...	Direct ..	Condensing....	Conc. feeders, triple conc. dist., laid direct	16,200 8 c.p.	50 arcs	16,200 (9 months)	7d. & 2d., 7d. & 1½d. ov. 1,500 u ½ yr., pwr. 1½d	Rebate ..	Hookham	420	Pea nuts ..	About £40,000	About £10,000	—	All.....	
2 100 kw.	Direct ..	Non-condensing	——	—	15 arcs, 377 posts, 2 8 c.p.	—	Lighting 4½d., power 3½d.	Flat rate	Thomson, Bastian, Long-Schattner (prepay.)	240	Welsh coal	—	—	—	All.....	
50 kw., 200 kw.	Direct ..	Non-condensing	Callender in stoneware casings	145,000 8 c.p.	—	16,000 ..	Ltg. 6d. to 3d., power 3d.	Brighton	Hookham	3,100	Welsh coal	—	—	—	Nearly ¾ of total	
2 100 kw.,	Direct ..	Non-condensing	Overhead and underground..	—	—	—	6d. and 2½d.	Wright's	Hookh'm, Ferranti and Aron	650	Welsh smokeless	—	—	—	—	
0 kw.	Direct ..	Ledward condensers	Ld. covd. B.I.W., rub. cables in iron pipes & bare strip in cul.	199,098 8 c p.	—	16,636 ..	6d. at 100 v., 5d. at 200 v. power 4d.	Rebate ..	Aron, Ferranti, and Hookham	1,000	Welsh coal	£290,000 whole system		6/–	142,363.....	
phase mtrs. 00 v. dyms	Direct ..	—	——	—	—	—	—	—	—	1,360	—	—	—	—	—	
00 kw.....	Direct ..	Non-condensing	B.I.W. cables and bare strip, in Doulton conduits	68,505 8 c.p.	—	9,351....	8d. at 100, 6d. at 200, 4d. day load	By meter	Aron, Ferranti, and Hookham	640	Welsh coal	£51,675	£95,684	6/5	About 90% of connections	
2 125 kw.	Direct ..	Surface condensing	B.I.W. paper ins. cab. fdrs., 6 core dist., 5 core laid solid in earthenware troughs	9,300.....	3,300 8 c.p., 190 arcs	12,600 ..	Ltg. 5d., 4d. & 3d., pr. 3d. & 1½d.	Wright..	Ferranti and Schattner	790 with battery	Pea nuts ..	£43,000	£50,000	—	All.....	
3 70 kw.,	Direct ..	Non-condensing	B.I.W. paper in Doulton conduits, rubber cables	—	240 arcs ..	—	Ltg. 5d. & 2d., m. d., 4½d. all r'nd, pwr. 2d. & 1½d.	Brighton	Ferranti and Hookham	1,450	Refuse and coal	—	—	—	None.....	
1 200 kw.	Direct ..	Non-condensing	Bare copper and Callender bitumen	Equivalt. of 23,239 8 c.p.	—	6,279....	6d. to 3¾d.*	Sliding scale	Hookham	800	Welsh steam coal	—	—	13/6	1,500 8 c.p.	
2 165 kw.,	Direct ..	Non-condensing	Lead covd. B.I.W. dist. laid solid, feeders lead covd. in conduits	18,352 8 c.p.	90 arcs, 180 32 c.p.	7,838* ..	6d., 4d. & 3d.; also discnts.	Maximum demand	Thomson	818	Pea size coking coal	£62,000	—	—	—	
in tandem engine, 2 large engs.	Direct ..	Non-condensing	B.I.W. solid, 3 single mains	Equivalent 14,187 8 c.p.	70 arcs, 5 32 c.p. incand.	13,878 ..	8d. 1st hr., 1d. after	Wright's	Reason.....	798 (without spare)	Welsh	—	—	—	All.....	
—	Direct ..	Non-condensing	Callender bitu., Siemens, bare copr., and B.I.W.	186,347 8 c.p.	61 arcs	21,597 ..	Ltg. 6d. to 4d., less 8 %, pwr. 3d.	1st 4,000 6d., aft. 4d., less 8 %	Hookham, Ferranti, Aron, and T. H.	3,880	Coal	—	—	9/8	—	
0 kw., 14 0 kw.	Direct ..	2,000 h.p. condensing	Callender in casing, arm'rd and paper cables, B.I.W.	219,860 8 c.p.	113 arcs ..	39,431 ..	Lighting 6d., power 4d.	Sliding scale	Aron, Ferranti, and Hookham	5,020	Welsh coal	—	—	—	—	
kw.	Direct ..	Condensing....	Bare strip and armoured cable	141,681 8 c.p.	426 arcs ..	31,219 ..	Indictr. systm., 6d. & 2d., or 5d. all ro'nd	Brighton, optional	Aron, Hookham, Ferranti, and Thomson	3,690	Coal	£163,583 inclu. land	£173,222	6/1½	—	
1 45 kw., at 1,000 v.	Ropes and direct	Non-condensing	B.I.W. lead covd. in ground, & Callender solid in trough-ing	30,000 8 c.p.	—	4,000....	6d., 5d. and 4½d.	Rebate ..	Ferranti, Hookham, and Aron	825	Welsh coal	—	—	6/1	None.....	
kw.	Direct ..	Non-condensing	Armoured, strip and casing..	—	12 arcs	48,144 ..	Lighting 6d., pwr. 3d., with rebates	Rebates and discounts	Aron, Ferranti ..	7,778	Welsh coal	—	—	6/9	All new consumers	
1 100 kw.,	Direct and belts	Surface cndnsg.	Callender lead, cov. ar., 3 core dis. tpl. fdrs., vul. bit. dis. in c.i. ps.	19,425	—	9,402....	Lighting 6d., power 3d.	Discounts to 20 %	Ferranti, Aron, and Hookham	680	Welsh coal	£35,341	£12,476	5/9	—	

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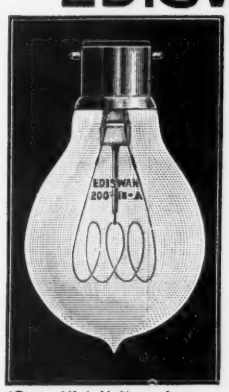

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ook-	1,080	Small coal	£55,000		8/3	None	100 v. and	35 = 160 h.p. ..	——	F. H. Chaplin	Southampton ‡ (101)					

		1 240 kw.											
, 2 100 h.p., 1 500 h.p., ., Belliss	Crompton, 1 Schuckert, 300 kw.	3 120 kw., 2 100 kw., 1 90 kw., 2 60 kw., 1 30 kw., 1 60 kw. motor, 1 300 kw.	Direct ..	Non-condensing	Bare strip, diatrine conc. for altern. mains	18,000 8 c.p.	62 arcs	7,337....	Lighting 6d., power 3d.	Brighton	Ferranti, Hookham, Aron, and Shallenberger	1,080	Sma
.....	E.C.C.....	3 66 kw. each	Rope ..	Jet condenser ..	Callender solid bit. system ..	8,558 8 c.p.	4 arcs	1,212....	Ltg. 5d., pwr. 2½d., 2d., spl 2½d. to 1½d.	—	Hook'm, Ferranti, and Thomson	198	Cok co ro
.....	1 Crompton, 2 Kapp, 1 Veale	1 44 kw., 2 21 kw., 1 9 kw.	Belts and counter shafting	Non-condensing	Parallel	3 arcs, 2,000 incand.	—	—	—	Rebate 6½d., 3½d.	Hookham	95	Coa
Willans	Johnson-Phillips alternators; Mather-Platt and Dick-Kerr, direct current	1 125 kw., 1 25 kw., A.C.; 2 125 kw., 2 215 kw., 1 320 kw., D.C.	Direct ..	Condensing....	H.P. feeders., B.I.W. paper ins., L.P. single cables	68 arcs, 19,688 8 c.p.	35 arcs, 12 amp., 72 16 c.p.	7,293....	Lighting 4½d., power 2d.	Flat rate, 2½ % dis. on pwr.	Thomson, Hookham, and Aron	1,000	Slad an
Belliss	Mather-Platt, 4 pole	2 75 kw., 4 12 kw...	Direct ..	Non-condensing	Callender feeders, conc. and dist., triple conc. laid direct, arc, sin., sol. & arm., laid dir.	5,200.....	30 arcs, 21 16 c.p.	Supply as started, Mar. '00	Ltg. 6d. & dis., pr. 4d., 3d., 2d.	Discounts	Ferranti	198	Nut
Willans....	McClure-Whitfield	56 and 140 units....	Direct ..	Non-condensing	Armoured	—	36 arcs....	7,700....	5d. and 2½d.	Direct ..	Ferranti & Reason	450	Cok
.....	Brush multi-polar.....	2 150 kw., 2 25 kw.	Direct coupled	Non-condensing	Con. & triple con., arm. bit. cbls. laid in wood troughs	4,800 8 c.p.	36 arcs....	—	Ltg. 6d. & 2½d., pwr. 5d. & 1d.	Max. dem.	Ferranti	350	Stea
.p., Belliss;	Holmes, Parker, Crompton, Sunderland Forge & Silvertown	2 26 kw., 5 125 kw., 6 275 kw., 2 38 kw.	Direct ..	Non-con.; Wh'el'r surf. con. & cool. tower	Bare strip, Silvertown, in c.i. pipes and Doulton casing, and Callender solid	48,500 8 c.p.	54 arcs * ..	—	Lighting 5d., power 2½d.	Bright'n & flat rate with dis.	Ferranti, Thomson, & Hookham	2,327	Sma Du
	Brush, driven by power supplied from Rother Vale Col'ry	14 kw.	Belt	—	Overhead.....	—	23 arcs....	—	—	—	—	—	
.....	Parker	84 kw.	Direct ..	Non-condensing	Callender triple conc. fdrs. 3 core dis., arm'd.	—	24 arcs, 100 incand.	3,500....	7d. and 4d.	Wright's max. dem.	Hookham, Aron, Reason, and Ferranti	168	Stea
, 2 vertical	Parker	3 80 kw., 2 180 kw...	Direct ..	Condensing....	H.P. con. rub., Callender v.b. solid, lead shethd. in i.p., L.P. Call., arm'rd, in grnd.	16,457 8 c p.	19 arcs	3,844....	Ltg. 6d. & 2d., power 2½d. & 1d.	Brighton	Hookham	600	Slac
.....	Crompton	35 kw.	Direct ..	Condensers (Ledward)	I.R. cables in earth. pipes and lead cov. B.I.W., solid	12,000 8 c:p.	485 incand., 9 arcs	2,976	5d., £6 per kw., power 2d.	Flat rate, etc.	Hookham, Ferranti, and Aron	210	Unv
.p., Willans	G. E. multipolar	2 150 kw., 2 210 kw.	Direct ..	Condensing....	3 wire	6,500.....	—	—	7d. and 2d.	Demand indicator	Aron and Hookham	720	Slac
Belliss	Parker	2 115 amps., 1 410 amps.	Direct coupled	Non-condensing	Tri. conc. feeders, 3 core dis.	10,000	—	6,228....	7d., 5d. and 2d.	Wright's	Ferranti	293·5	Wels les coa
i.h.p., 1 160 i.h.p., Belliss	Siemens	—	Direct ..	Non-condensing	Triple conc. armoured	30 arcs, 15,484 8 c.p.	290 16 c.p., 34 arcs	7,957 ..	Lighting 6½d., power 4d.	50 % reb. af. ern. 12s. 8 c.p. an.	Ferranti, Hookhm., Thomson, Aron, Bastian, Schattner	625	Pow
1 200 h.p.,	E.C.C. and Parker	4 140 kw., 1 70 kw., 2 220 kw., 2 500 kw.	Rope and direct	Ledward ejector condensers	Callender solid	29,361 8 c.p.. 2,584 power and heat	51 arcs	6,673 8 c.p. 1,817 pwr and heat	6d. and 3d.	Brighton	Ferranti, Hookh'm, Aron, & Bastian	2,000	Forg
.....	Crompton	4 75 kw., 2 220 kw...	Direct ..	Condensing....	Conc. feeders, triple conc. dist., laid direct	16,200 8 c.p.	50 arcs	16,200 (9 months)	7d. & 2d., 7d. & 1½d. ov. 1,500 u ½ yr., pwr. 1½d	Rebate ..	Hookham	420	Pea
Sunderland	Sunderland Forge Co.....	2 20 kw., 2 100 kw.	Direct ..	Non-condensing	——	—	15 arcs, 377 posts, 2 8 c.p.	—	Lighting 4½d., power 3½d.	Flat rate	Thomson, Bastian, Long-Schattner (prepay.)	240	Wel
.....	E.C.C.	80 kw., 150 kw., 200 kw., 400 kw.	Direct ..	Non-condensing	Callender in stoneware casings	145,000 8 c.p.	—	16,000 ..	Ltg. 6d. to 3d., power 3d.	Brighton	Hookham	3,100	Wel
Willans	Siemens, Holmes, Crompton, Latimer Clark, E.C.C.	6 50 kw., 2 100 kw., 1 150 kw.	Direct ..	Non-condensing	Overhead and underground..	—	—	—	6d. and 2½d.	Wright's	Hookh'm, Ferranti and Aron	650	Wel sm
p., 2 80 h.p.,	Siemens and Crompton	50 and 150 kw.	Direct ..	Ledward condensers	Ld. covd. B.I.W., rub. cables in iron pipes & bare strip in cul.	199,098 8 c p.	—	16,636 ..	6d. at 100 v., 5d. at 200 v. power 4d.	Rebate ..	Aron, Ferranti, and Hookham	1,000	Wel
., 3 300 kw.,	——	5,000 v. 3 phase mtrs. driving 200 v. dyms	Direct ..	—	——	—	—	—	—	—	—	1,360	
.....	Crompton and Siemens	120 and 200 kw.....	Direct ..	Non-condensing	B.I.W. cables and bare strip, in Doulton conduits	68,505 8 c.p.	—	9,351....	8d. at 100, 6d. at 200, 4d. day load	By meter	Aron, Ferranti, and Hookham	640	Wel
p., Belliss ..	Mather-Platt	2 250 kw., 2 125 kw.	Direct ..	Surface condensing	B.I.W. paper ins. cab. fdrs., 6 core dist., 5 core laid solid in earthenware troughs	9,300.....	3,300 8 c.p., 190 arcs	12,600 ..	Ltg. 5d., 4d. & 3d., pr. 3d. & 1½d.	Wright..	Ferranti and Schattner	790 with battery	Pea
p., Willans;	E.C.C.	3 165 kw., 3 70 kw., 3 250 kw.	Direct ..	Non-condensing	B.I.W. paper in Doulton conduits, rubber cables	—	240 arcs ..	—	Ltg. 5d. & 2d., m. d., 4½d. all r'nd, pwr. 2d. & 1½d.	Brighton	Ferranti and Hookham	1,450	Refu coa
1 300 h.p.,	4 E.C.C., 1 Parker	4 125 kw., 1 200 kw.	Direct ..	Non-condensing	Bare copper and Callender bitumen	Equivalt. of 23,299 8 c.p.	—	6,279....	6d. to 3½d.*	Sliding scale	Hookham	800	Wels coa
., 1 750 h.p.,	4 Johnson-Phillips	1 88 kw., 2 165 kw., 1 400 kw.	Direct ..	Non-condensing	Lead covd. B.I.W. dist. laid solid, feeders lead covd. in conduits	18,352 8 c.p.	90 arcs, 180 32 c.p.	7,838* ..	6d., 4d. & 3d.; also discnts.	Maximum demand	Thomson	818	Pea cok
o., Willans..	Mather-Platt 4 pole	2 60 kw. in tandem on small engine, 2 275 kw. on large engs.	Direct ..	Non-condensing	B.I.W. solid, 3 single mains	Equivalent 14,187 8 c.p.	70 arcs, 5 32 c.p. incand.	13,878 ..	8d. 1st hr., 1d. after	Wright's	Reason.....	798 (without spare)	Wels
.....	Siemens	—	Direct ..	Non-condensing	Callender bitu., Siemens, bare copr., and B.I.W.	186,347 8 c.p.	61 arcs	21,597 ..	Ltg. 6d. to 4d., less 8 %, pwr. 3d.	1st 4,000 6d., aft. 4d., less 8 %	Hookham, Ferranti, Aron, and T. H.	3,880	Coal
14 8,000 h.p.	Mather-Platt and Siemens ..	6 total 620 kw., 14 total 4,400 kw.	Direct ..	2,000 h.p. condensing	Callender in casing, arm'rd and paper cables, B.I.W.	219,860 8 c.p.	113 arcs ..	39,431 ..	Lighting 6d., power 4d.	Sliding scale	Aron, Ferranti, and Hookham	5,020	Wels
s; 3 660 i.h.p., , Peache	Kapp, Latimer, Siemens, and Crompton	50 to 500 kw.	Direct ..	Condensing....	Bare strip and armoured cable	141,681 8 c.p.	426 arcs ..	31,219 ..	Indictr. systm., 6d. & 2d., or 5d. all ro'nd	Brighton, optional	Aron, Hookham, Ferranti, and Thomson	3,690	Coal
0 h.p. nom., ; 3 280 h.p.,	E.C.C.....	2 90 kw., 1 45 kw., 3 200 kw., at 1,000 v.	Ropes and direct	Non-condensing	B.I.W. lead covd. in ground, & Callender solid in troughing	30,000 8 c.p.	—	4,000....	6d., 5d. and 4½d.	Rebate ..	Ferranti, Hookham, and Aron	825	Wels
.p.	E.C.C., Crompton, Siemens, and Goolden	Up to 225 kw.	Direct ..	Non-condensing	Armoured, strip and casing..	—	12 arcs....	48,144 ..	Lighting 6d, pwr. 3d., with rebates	Rebates and discounts	Aron, Ferranti ..	7,778	Wels
arsons trbns.; 1 110 kw.,	Parsons, Allen, Easton-Anderson-Goolden	3 110 kw., 1 100 kw., 1 250 kw.	Direct and belts	Surface cndnsg.	Callender lead, cov. ar., 3 core dis. tpl. fdrs., vul. bit. dis. in c.i. ps.	19,425	—	9,402....	Lighting 6d., power 3d.	Discounts to 20 %	Ferranti, Aron, and Hookham	680	Wels

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Telegrams: "Rickard."

OF EVERY DESCRIPTION.

DISCOUNTS.

Western Electric Co.,

Cables, Rubber Wires, Motors.

WESTERN ELECTRIC CO.,

(Late Fowler Waring Cables Co.),

NORTH WOOLWICH, E.;

CHICAGO, ANTWERP, NEW YORK, BERLIN, PARIS, ETC.

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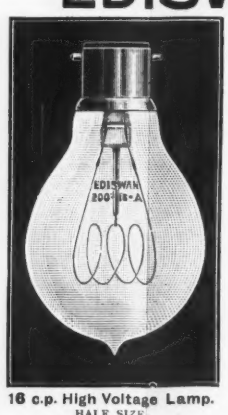

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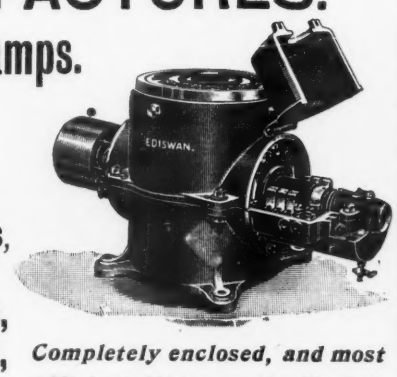

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Hook- and er	1,080	Small coal	£55,000		8/8	None	100 v. and 200 v.	35 = 160 h.p. ..	—	F. H. Chaplin	**Southampton ‡ (101)**
anti, on	198	Coke breeze coke, and rough slk.	£20,000	£4,000	4/2	5,000.....	105 v. and 210 v.	34½ h.p.	—	H. Pooley	**Stafford .....(102)**
....	95	Coal.....	£6,000	—	—	—	100 v.	14 = 14½ h.p..	—	J. M. Coon	**St. Austell ....(103)**
Hook- ron	1,000	Slack thro' and thro'	Ltg. £21,500* tr. £17,800	£13,800	4/6	All.....	230 v.	38 = 180 h.p..	Combined ltg. and tr. sys. Chlor. batt. *This also incl. cap. on old A.C. sta.	J. S. Highfield..	**St. Helens ....(104)**
....	198	Nuts and dross	—	—	—	—	230 v.	10 = 7 h.p.....	First year of working. Extensions on order, 2 360 h.p. sets	A. C. Hanson..	**Stirling .....(105)**
ason	450	Coke breeze	—	—	23/4 units	—	230 v.	1 = 80 h.p., 1 = 4 h.p.	—	S. Meunier, A. J. H. Carter, (electrical man.)	**Stockport ....(106)**
....	350	Steam coal	£28,000	£11,000	—	All.....	230 v.	4 = 6½ h.p.....	—	J. J. Smith. Wm. Ford, genl. mnger.	**Stockton-on-Tees (107)**
nson,	2,327	Small coal, Durham	£73,680	£48,446	5/1	About half total wired	110 v. and 220 v.	560 h.p.	* 100 arcs to be added ..	John F. C. Snell	**Sunderland....(108)**
	—	—	—	—	—	—	—	—	—	Wm. H. Barwell	**Treeton.....(109)**
Aron, ranti	168	Steam coal	—	—	—	—	210 v.	10 = 13 h.p. ..	—	A. E. Mayes....	**Ventnor.....(110)**
....	600	Slack	£24,800	£9,500	5/9	None	105 v. and 210 v.	31 = 65 h.p. ..	—	A. Wyllie	**Walsall .....(111)**
ranti,	210	Unwashed nuts	£23,885	£9,469	8/2	About 250	105 v. and 100 v.	2 = 13 h.p.....	—	E. W. Dunton	**Whitehaven ..(112)**
ham	720	Slack.....	—	—	—	—	230 v.	60 kw.	—	H. Collings Bishop	**Wigan .....(113)**
....	293·5	Welsh sm'keless steam coal	£20,335	£6,280	3/6	2,705 lamps....	210 v.	2 = 6 h.p.	—	H. N. Warburton	**Winchester † ..(114)**
khm., Aron, ttner	625	Powell Duffryn	£23,000	£21,400	—	2,300 8 c.p.	110 v. and 220 v.	32·5 h.p.	Wright's max. demand being introduced	A. E. Farrow ..	**Windsor .....(115)**
kh'm, tian	2,000	Forge coal	£81,000	£27,000	7/6	4,000.....	220 v.	22 = 87½ e.h.p...	—	C. E. C. Shawfield	**Wolverhampton (116)**
....	420	Pea nuts ..	About £40,000	About £10,000	—	All.....	230 v.	Several on order	Plant not all installed yet. Sup. com. April, 1900. Further exten. contem.	C. H. Midgley..	**York .....(117)**
											LONDON.
tian, ner bay.)	240	Welsh coal	—	—	—	All.....	230 v.	17 h.p.....	—	A. Hugh Seabrook	**Barking .....(118)**
....	3,100	Welsh coal	—	—	—	Nearly ¾ of total	200 v.	—	—	Percy Still	**Chelsea .....(119)**
ranti	650	Welsh smokeless	—	—	—	—	100 v. to 110 v.	—	—	H. J. Brownrigg	**Hampstead ....(120)**
, and	1,000	Welsh coal	£290,000 whole	system	6/–	142,363.....	200 v.	22 = 85 h.p. ..	Albert Vaults transformer station supplied from Wood Lane works and feeding into general network	H. W. Miller..	**Kensington ....(121)**
	1,360	—	—	—	—	—	—	—			
ti, ham	640	Welsh coal	£51,675	£95,684	6/5	About 90% of connections	100 v. and 200 v.	21 h.p.	—	Geo. Schultz ..	**Notting Hill ..(122)**
tner	790 with battery	Pea nuts ..	£43,000	£50,000	—	All.....	230 v. and 460 v.	4 = 45 h.p.....	Supply commenced Oct., 1900	Alfred Blackman	**Poplar .....(123)**
ham	1,450	Refuse and coal	—	—	—	None.....	150 v.	About 900 b.h.p.	—	C. Newton Russell	**Shoreditch ....(124)**
....	800	Welsh steam coal	—	—	13/6	1,500 8 c.p.	100 v. and 200 v.	—	* Price inclu. free wiring, mainten., clng. & renewals	Eustace Ridley	**Smithfield Markets (125)**
....	818	Pea size coking coal	£62,000	—	—	—	220 v.	Equiv. of 1,341 8 c.p.	*March, 1900, to January, 1901	J. R. Blaikie ..	**Southwark ....(126)**
....	798 (without spare)	Welsh	—	—	—	All.....	240 v.	23 = 114 h.p...	—	A. Wright, consit. W. C. P. Tapper, resident	**Stepney .....(127)**
Fer- and	3,880	Coal	—	—	9/8	—	107 v. and 214 v.	—	—	Sydney T. Dobson	**St. James's Parish (128)**
nti, n	5,020	Welsh coal	—	—	—	—	100 v. and 200 v.	—	Work under the City of London Order, 1899, in hand	W. H. Patchell	**St. Martin's in the Fields, Strand District. S. Holborn, St. Giles, and the City of London (129)**
am, d	3,690	Coal	£163,583 inclu. land	£173,222	6/1½	—	110 v. and 220 v.	136 = 516 h.p.	—	S. W. Baynes..	**St. Pancras....(130)**
nam,	825	Welsh coal	—	—	6/1	None.....	100 v.	3 = 100 h.p. ..	—	A. L. Phillips..	**Sydenham ....(131)**
..	7,778	Welsh coal	—	—	6/9	All new consumers	200 v.	—	—	Dr. A. B. W. Kennedy	**Westminster and St. George's (132)**
and	680	Welsh coal	£35,341	£12,476	5/9	—	210 v.	6 = 19 h.p.....	Messrs. Edmundson, con. engs.	A. J. Fippard	**Woolwich ....(133)**

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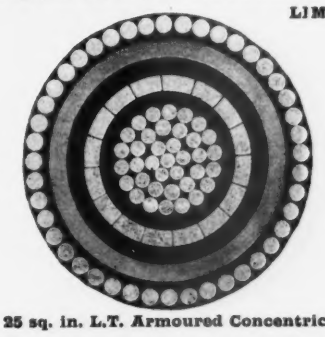

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